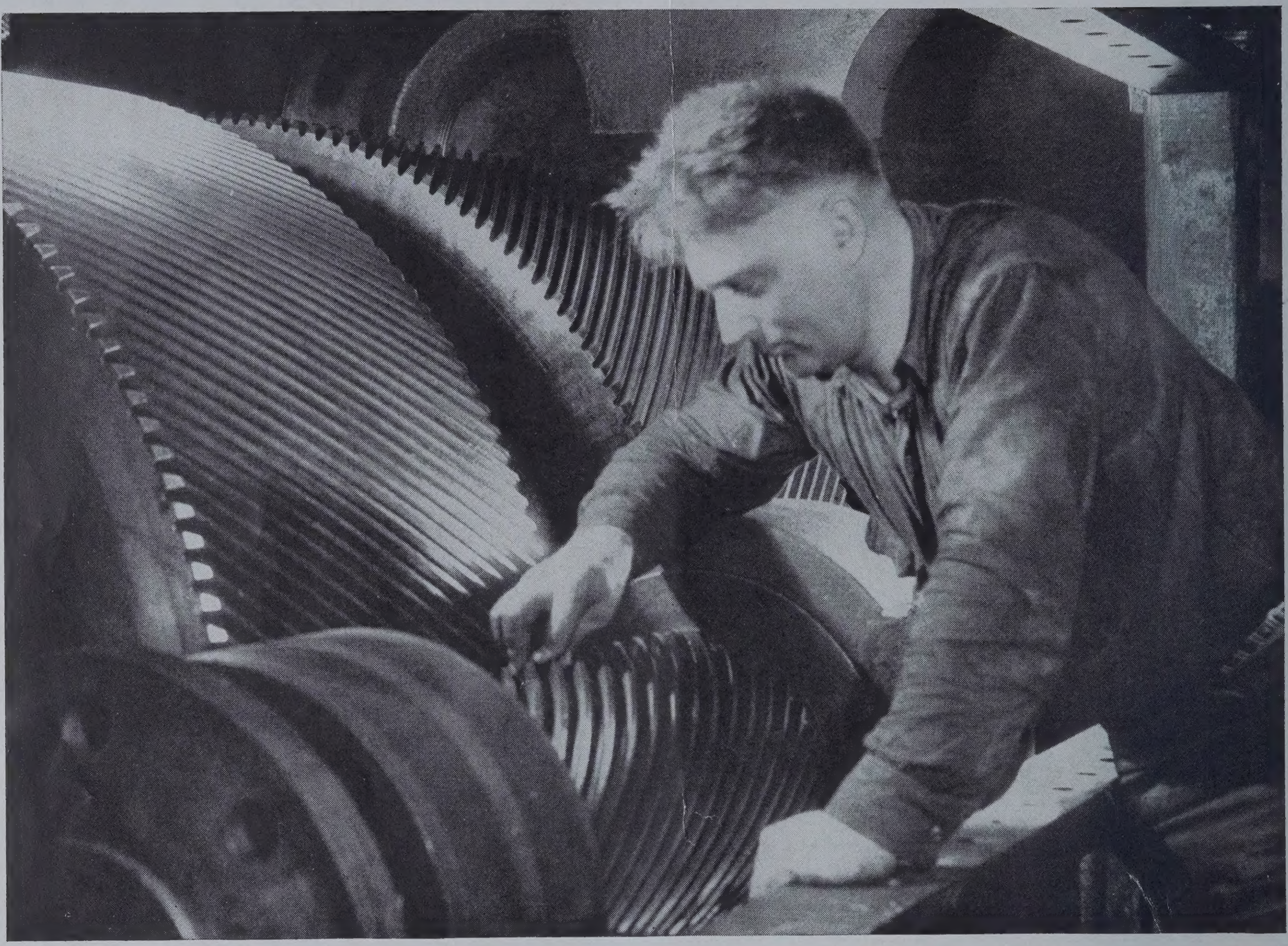
Marine Engineering and Shipping Review

JANUARY, 1936



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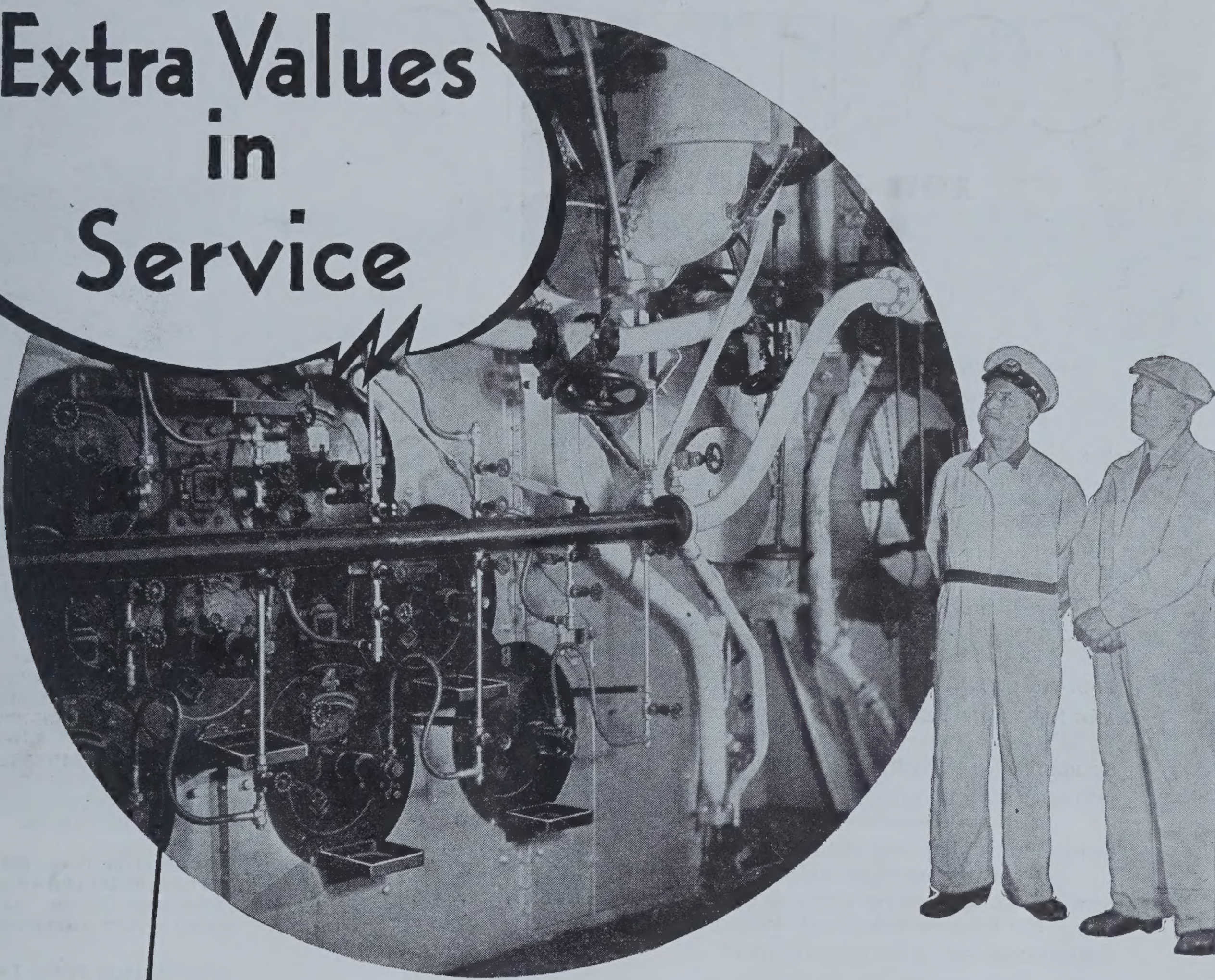

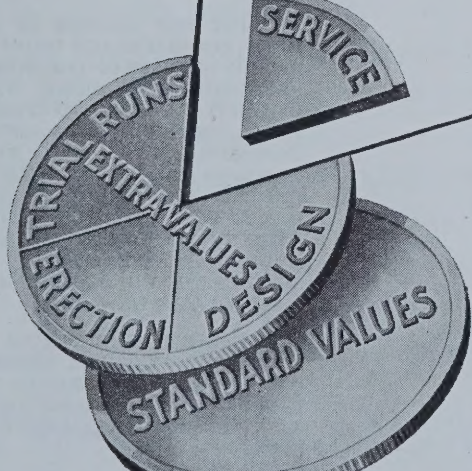

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MARINE ENGINEERING AND SHIPPING REVIEW

With which is incorporated the Marine Review. Reg. U. S. Pat. Off.

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EDITORIAL

DEPARTMENTS

Marine Engineering and Shipping Review

The New Ship Subsidy Bill

According to all indications ship subsidy legislation will be one of the first items of business to receive consideration at the new session of Congress. The President realizes that progress in the development of American shipping will remain at a standstill until Congress establishes a new shipping policy and enacts legislation to carry out this policy.

Senator Copeland, chairman of the Senate committee on commerce, has prepared for introduction at the opening of Congress a new subsidy bill which while not 100 percent perfect in every respect would go a long ways toward solving the problems which shipowners are obliged to face. Senator Copeland has wisely eliminated from the ship subsidy bill many of the controversial provisions relating to the manning of ships which were included in the bills presented before the last session. These provisions have been incorporated in a supplementary bill which will be introduced with the ship subsidy bill but acted upon separately. Congress will, therefore, be given an opportunity to act on a clear-cut issue regarding the method of extending financial aid to the upbuilding of the merchant marine.

The new ship subsidy bill proposes to create a Maritime Authority composed of three members appointed by the President and approved by the Senate to serve at salaries of $12,000 a year. The Maritime Authority will have complete control over subsidies for the building and operation of ships and also over the regulation of shipping.

Existing mail contracts will remain in force for one year after the members of the Authority have been appointed and qualified, but the Authority is authorized to settle or cancel these contracts as soon as practicable. No settlement or cancellation involving payment or credit, however, will be agreed upon or determined until thirty days after the Authority has transmitted to the Senate committee on commerce and the House committee on merchant marine and fisheries, while Congress is in session, a report stating the maximum amount proposed to be paid or credited and setting forth in detail its determination and all considerations on which the settlement is based. If an agreement is impossible or the amount of compensation unsatisfactory, the shipowner will receive such portion as the Authority determines and may sue the United States to recover the remainder.

Two forms of subsidy are proposed in the bill; one is a construction subsidy and the other an operating subsidy. The ship construction differential subsidy may be applied in two ways. If the plans and specifications of a new vessel are approved by the Secretary of the Navy, the Authority may secure bids for its construction, award the contract to the lowest responsible bidder and, if accepted by the applicant, agree to pay to the shipbuilder on behalf of the applicant a construction differential subsidy equal to the excess of the bid of the shipbuilder over the cost of building the vessel abroad, provided the construction differential payment does not exceed 33⅓ percent of the total cost of the vessel exclusive of military features. In exceptional cases, however, the amount of construction differential payment may be extended to 40 percent of the cost of the vessel. If the differential is greater than 40 percent, the Authority may build the vessel and charter it to the applicant.

Under this plan, where the Authority builds the vessel, pays the entire cost and sells the ship to the shipowner at a price corresponding to the cost of building it in a foreign shipyard, the shipowner is required to pay the Authority 25 percent of the foreign cost of the vessel, the balance to be paid in not over twenty annual instalments with interest at 3½ percent on all unpaid instalments. The same arrangement applies to the construction of vessels for coastwise service except that the construction subsidy is eliminated. This plan is essentially the so-called Haag plan, which was turned down by both the Senate and House committees last year and which was opposed by the majority of opinion expressed in the Propeller Club questionnaire after Congress had adjourned. A more preferable method suggested was for the shipowner to contract with the shipbuilder, the Government contributing a sum equal to the difference between the foreign and domestic costs as is outlined in the second method of subsidizing vessel construction proposed in the bill.

The second way in which the construction differential subsidy may be applied is in the case when the ship-

owner desires to finance the construction of a vessel rather than to purchase it from the Authority as outlined above. In this case the Authority may permit the shipowner to obtain and submit to it competitive bids and after approving the lowest bid it may become a party to the contract for the construction of the vessel and agree to pay to the shipbuilder the difference between the contract price and the cost of building the vessel in a foreign yard. In this case the shipowner pays to the shipbuilder the foreign cost of the vessel. Means for aiding the shipowner in financing such a transaction are provided in the bill by an amendment to the Reconstruction Finance Corporation Act, authorizing the Reconstruction Finance Corporation to make loans to American shipowners for such purposes. In the case of building a vessel for foreign trade the shipowner would pay 25 percent of the foreign cost of the vessel while the Reconstruction Finance Corporation is authorized to purchase the notes or other obligations of indebtedness of the shipowner representing not more than 75 percent of the foreign cost of the vessel, the payment of this sum to the Finance Corporation being divided into 15 equal instalments with interest at 3½ percent on unpaid instalments. Provision is also made in the bill authorizing the construction of a vessel in a Pacific Coast shipyard for a line operating from a Pacific Coast port provided the lowest bid of the Pacific Coast yard is not more than 6 percent greater than the lowest bid on the Atlantic Coast. Where a ship is being built on the Pacific Coast with an RFC loan the minimum rate of interest on the loan is 2¾ percent instead of 3½ percent.

Under the conditions imposed by this bill the shipbuilder is limited to a profit of 10 percent of the total contract price as is the case in naval contracts.

While the new bill abolishes the construction loan feature in accordance with the wishes of the President, the substitution of loans from the Reconstruction Finance Corporation merely changes the set-up. The new arrangement is advantageous to the shipowner, however, as both the initial payment and the loans are based on the foreign cost of the vessel instead of on the American cost. RFC loans are also available for the construction and reconditioning of vessels in the coastwise or inland waterway services.

An important feature of the new bill is a provision for aiding the construction of high-speed tankers to meet Navy requirements. The Authority is authorized to pay to shipbuilders certain sums per deadweight ton for the construction of tankers ranging from 7500 to 20,000 tons deadweight and from 15 to 18 knots sea speed. Such vessels are not eligible for other subsidies and are available to the Government in cases of emergency. This provision, which is limited to a ten-year period and for which an annual expenditure of $5,000,000 is provided, would bring into existence a fleet of modern tankers of higher speed than would otherwise be built for commercial use. These vessels would be invaluable as naval auxiliaries.

The operating differential subsidy applies only to vessels in foreign trade and is limited to the difference in operating costs of American and foreign vessels on competitive routes. Before distribution of profits the shipowner is required to set aside a reserve fund for payment of mortgage debts, replacement of vessels and a reasonable operating reserve fund. When at the end of any fiscal year the cumulative net profits, after setting aside the reserve, exceed 6 percent, all the operating subsidy payments become subject to recapture by the Government. Salaries in excess of $25,000 per annum will not be considered as an expense in arriving at the amount available for reserve funds, or the amount of the cumulative profits.

Agreement on Cabin Liner

The signing of a contract for the construction of a 23,000-ton cabin liner in the closing days of the year 1935 constituted the outstanding order in a year marked by a dearth of merchant ship construction. As noted elsewhere in this issue, on December 16, the last day of grace allowed by a contract with the Department of Commerce, the United States Lines reached an agreement for the construction of this vessel with the Newport News Shipbuilding and Dry Dock Company.

Considerable of a muddle has attended the design of the ship, and the two requests for proposals resulted only in one definite bid, that of the Newport News Company on December 7, which was accompanied by complete plans and specifications for a vessel essentially conforming with the ideas of the owners. The facts of the situation are too well known throughout the marine industry to require further comment. It might be said, however, that the development of this proposition from its inception hardly constitutes a pattern to be followed by shipowners in the future who desire to build new ships. To say the least, it is a wasteful procedure and places a burden of needless expense on every shipyard which would submit proposals on such work.

Even in the contract drawn up between the United States Lines and the Newport News Company the matter of design was not entirely settled. Structural changes and bulkheading arrangements thought to be desirable by the owners require the development of practically a new design by the shipyard, which will not be completed until some time in January. Until the plans have officially been submitted to the Shipping Board Bureau and approved by the Navy Department the necessary construction loan grant cannot be made. No difficulty, however, is expected on this score.

In the interest of the entire marine industry it is well that agreement was reached even with official approval still to be obtained. Certainly it is to the Administration's advantage as well as to that of both shipbuilders and ship operators in general that this difficult situation was solved satisfactorily before it could be injected into the consideration of the forthcoming legislative program.

THE SHIPPING OUTLOOK

Record Travel Predicted to West Coast

Capacity passenger business by intercoastal steamship lines operating between Atlantic and Pacific Coast ports, via the Panama Canal, has been predicted by traffic experts as a result of the heavy advance bookings that are being made for the next three months. For example, the Panama Pacific Line's future reservations for the next six sailings show an increase of 60 percent above the corresponding period of 1934.

Italy Still Buying Scrap

Italian representatives in this country are trying to obtain shipments of 200,000 tons of steel scrap still due to Italy on purchases made in August. In addition, bank credit is understood to have been established at New York for the purchase of an additional 100,000 tons of steel scrap on a cash basis.

Sharp Rise in Export Trade

A sharp upturn in the export of domestic products in November, 1935, contrary to the seasonal movement, was noted by the Bureau of Foreign and Domestic Commerce in its report for the month on United States foreign trade. The total value of exports increased sharply in November, chiefly due to larger shipments of unmanufactured cotton, automobiles, and petroleum products. This increase amounted to 22 percent as compared with October, 1935, whereas in recent years exports have declined about six percent on the average. Compared with November, 1934, the November, 1935, value was 38 percent greater. The total of November exports, including the value of re-exports of foreign merchandise, was $269,400,000, a larger amount than in any month since December, 1930.

This gain in export business was accompanied by decline in imports. Over a period of years, imports have declined about 2 percent from October to November. In November, 1935, however, the decline was 11 percent. However, compared with November, 1934, the November, 1935, value of imports was 12 percent higher and amounted to $168,955.

Merchandise exports, therefore, have exceeded imports by approximately $100,000,000, a greater net balance than the total balance during the entire 10 preceding months.

Trade Agreements Benefit Commerce

The United States Chamber of Commerce in its report for the third quarter of the year expresses the opinion that reciprocal trade agreements are helping to break down business barriers in foreign trade. A wide range of farm exports have shown considerable gain in spite of political unrest abroad.

On December 20 the United States entered into its ninth reciprocal trade agreement when Secretary of State Hull and A. T. Damping, director of trade agreements for the Netherlands, signed a pact at the State Department. The treaty will become effective February 1. In 1934 trade between the United States and the Kingdom of the Netherlands (including the Dutch East Indies) aggregated $155,500,000 as compared with $431,000,000 in 1929. The present pact provides for increased purchases of American wheat by the Netherlands, if the price meets foreign competition, as one condition of the trade treaty. It also provides mutual tariff concessions involving outright duty reductions on some commodities, guarantees to bind or maintain others on free lists and commitments not to increase duties on still others. It is hoped by these means to restore a large proportion of the business lost with that nation in recent years.

Trade pacts also were signed during December with Honduras, Guatemala, shortly to be followed by pacts with the remaining Latin America republics. Trade agreements have already been made with Cuba, Haiti, and Brazil. With Colombia, agreement only awaits ratification by that government.

Matson Predicts Heavy Pacific Trade

With a sailing every week from San Francisco and Los Angeles for Honolulu, and a sailing every four weeks from Californian ports for New Zealand and Australia via Hawaii, Samoa and Fiji, the Matson Navigation Company recently reported a steady increase in passenger travel. According to John E. Ryan, general passenger manager of the company, the year 1935 produced more passenger business than any year since 1929, and 1936 is expected to establish a new record for Pacific and South Seas visitors from the United States.

Prospects Bright for Atlantic Passenger Business

Harold P. Borer, passenger traffic manager of Cunard-White Star, Ltd., in a year-end interview declared that the transatlantic travel outlook for 1936 is extremely encouraging. There is every indication, he stated, that the marked improvement during 1935 will continue, adding that his company's ships during the first eleven months of 1935 had carried 17 percent more passengers than in 1934.

Passenger traffic managers of virtually every transatlantic steamship company shared in the 1935 increase in business and are sanguine that their participation in the coming year will be equally good. In fact, arrangements are being made by most companies to handle still greater numbers in all classes in 1936.

In recent years, August and September have become increasingly popular months for summer vacations so that the peak season of transatlantic travel has been considerably extended. Another factor believed to be responsible for the improvement is the interest created in sea travel by the numerous popular cruises throughout the year. Many cruise passengers, it has been learned, later make their first transatlantic voyage.

The reports of the several conference lines from January 1 until October 25 indicated that with 17 fewer sailings in 1935 over the preceding year, the total number of passengers carried during the year was 449,814, as compared with 418,116 in the same period of 1934, or an increase of 31,698.

Isbrandtsen Challenges Rate Rules

By P. McEvoy

Power of the Shipping Board Bureau of the Department of Commerce to enforce its orders for the filing of reports of all rates charged and all commodities carried by the line is challenged by Hans J. Isbrandtsen, president of the Isbrandtsen-Moller Company, operating services from New York to the Far East and the Continent of Europe. Citing the President's executive order of June 10, 1933, transferring the functions of the Shipping Board to the Department of Commerce, Mr. Isbrandtsen expresses doubt that Congress, in granting the President authority to reorganize and consolidate bureaus, intended that an executive department should exercise discretionary powers over the American shipping industry.

He adds that his company has nothing to conceal from the Shipping Board Bureau and has offered to supply any data the bureau may desire for its own information, asking only that the details of its business and its customers' business shall not be made available to its competitors, the conference lines. The bureau, he states, has declined to accept this condition and made it clear that it intends to give the conference lines the benefit of the data which his line has been ordered to file under pain of a fine of $100 a day for failure to comply. The conference lines, he adds, have been asked to file their general rate schedules, but these general schedules are not and need not be adhered to, whereas his line is ordered to file actual rates charged on particular goods between named ports.

Referring to the almost complete monopoly by the conference lines of the Atlantic and Far East trades, Mr. Isbrandtsen says if his company can be brought into line the conference groups will be within sight of their goal, which is a one hundred percent monopoly of American foreign freight services. From their standpoint, he says, the existence of an independent line which operates successfully without any aid from any government is a constant threat and reproach. He states his belief that the bureau is sincerely convinced that the conference method of operation is beneficial to the country and that anything which hampers independent competition is commendable and expresses doubt that this view is shared by Congress or the people.

He also is concerned with the apparent inconsistency of the Shipping Board Bureau in ignoring the conference contract system with its penalties, etc., in foreign trade while condemning similar contracts in the intercoastal trade. So far as he is aware, he points out, no shipper has made any complaint against the line or its methods. The attacks, he adds, have all come from competitors who constitute one of the greatest monopolies in the world but find it necessary to invoke the aid of the government in order to make sure that no independent carrier can invade the waters of the United States. Referring to his company's operation of Danish tonnage, he asserts that the conference lines are predominantly foreign in numbers and tonnage.

He wonders why the power of the government should be exerted to foster a monopoly which is predominantly foreign and which is seeking control of American foreign commerce. The information which he has been ordered to file is not filed or made public in any other exporting country competing with American foreign trade. He concludes by expressing the belief that it may be against public policy for any concern to succeed by mere industry, economy and efficiency without any subsidy from taxpayers, but says he believes that American shippers and consignees are entitled to economical and competitive service and that they will demand it. His company, he adds, will continue to cater to that demand.

It is expected that court action may result from the deadlock reached in the controversy between Mr. Isbrandtsen and the Shipping Board Bureau. The conference between Mr. Isbrandtsen and his counsel and Secretary Roper on December 16, when the penalty of $100 a day became effective, was reported to have been a stormy one in which the failure of the line to comply with the order to file all charges was defended by Mr. Isbrandtsen. It has been intimated that the Shipping Board Bureau may start an action in the United States District Court to force compliance with the order under section 29 of the Shipping Act.

The first order for the filing of rates was issued by the Secretary of Commerce under section 19 of the Merchant Marine Act of 1920 and the specific order to the company was issued under section 21 of the same act. The company is determined to resist to the utmost the requirement that it shall have its rates and charges open to inspection by its competitors. It is still quite willing to have all rates and charges inspected by the Shipping Board Bureau.

The contention that the delegation of Shipping Board powers to the Department of Commerce by executive order is illegal has also been raised by the McCormick Steamship Company in an action now pending in the United States District Court for the Northern District of California. The Isbrandtsen-Moller Company and the United States Navigation Company have been a source of annoyance to the conference lines for several years in the transatlantic trade, but Isbrandtsen-Moller is at present the sole non-conference operator between New York and the Far East. It has fortnightly sailings in both Atlantic and Pacific trades.

Since its advent into the trade the company has added several new ships with a good turn of speed and equipped with refrigerated space and other up-to-date equipment. The vessels have long and exceptionally wide hatches which permit the easy handling of unwieldy items of cargo. The company feels that its policy of open rates is fully justified by the results of its operations to date and proposes to defend this policy to the last ditch.

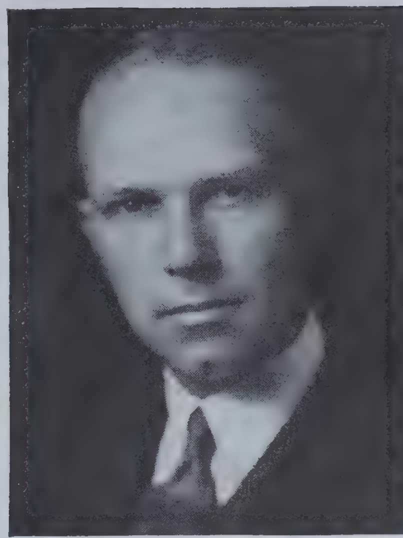
Cunard to Bolt Conference

The Cunard-White Star Line, owner of the new British liner *Queen Mary,* has given notice of withdrawal from the North Atlantic Passenger Conference. When Cunard-White Star applied to have the *Queen Mary* classified as a cabin ship the rating committee of the North Atlantic Passenger Conference is understood to have proposed that the *Queen Mary's* fares should be half way between those of the *Normandie,* of the French Line, and those of the *Manhattan,* of the United States Lines. This suggestion was not acceptable to Cunard-White Star.

Conferences, pools and agreements necessary in

Rationalizing American Merchant Shipping*

By Robert C. Lee†



Robert C. Lee

In 1916, the 64th Congress of the United States passed a bill which they fondly entitled: "Creating a Shipping Board; a Naval Auxiliary; a Merchant Marine; and Regulating Carriers by Water engaged in the Foreign and Interstate Commerce of the United States."

This act, which was to create a merchant marine, contained the well-known Section 14. This section provides, first, that there shall be no deferred rebates; second, that there shall not be fighting ships; third, that there shall not be any retaliation; fourth, that there shall be no unfair rates based upon volume. With the second, third and fourth prohibitions there can be no legitimate quarrel. The prohibition of the deferred rebate, however, is a blunder. No piece of legislation could be better designed to handicap the development of an American merchant marine. Of all the nations in the world that need a deferred rebate system, the United States leads. On account of our expenses, the United States does not, and probably never will have, any material position in tramp tonnage.

The British Imperial Shipping Committee, reporting on the deferred rebate system, which report was accepted in total by the Parliament of that country, made the following declaration:

"It is clear that competition between individual liners or lines in the same trade will be quite incompatible with stability of rates and that the trade would in fact tend to return to the disturbed conditions which prevailed before the introduction of the conference system, or to those characteristics of the tramp market. The shippers might for a time secure the benefit of low cut rates, but there would inevitably be a strong tendency to abandon regularity in sailings, and there would be no guarantee such as obtains at present of any general progress in the type of vessel plying and the nature of the facilities afforded. We consider, therefore, that the conference system must be accepted as a necessary concommitant of modern commerce. It has been further strongly urged that as a general rule these conferences could not remain in being unless they have some assurances of continued support from their customers. The shippers in a particular trade should be in some manner tied to it. Under the deferred rebate system, the shipowners feel themselves under an obligation to provide sailings at regular intervals, the vessels sailing full or not full, to keep rates stable, and to treat large and small shippers alike. The fact that a trade was open to all shipowners would lead to the inclusion of outside ships at times when the trade was flourishing, or enable large shippers to charter to the detriment of smaller shippers, while retaining the right to use the liner services when it suited them. These outside ships would quickly disappear when the seasonal or periodical depression set in."

Let us examine the record and see how wise these British shipping men were. We have seen in the United States in the last fifteen years the formation of a number of conferences. A review of the Department of Commerce publication listing "Approved Conference Agreements" on file as of August 15, 1935, shows that practically every important American and foreign line operating to America is in conference agreement. These conferences have done more than anything else to promote international good will and development of shipping in the liner trades.

If conferences are to be successful, there must be a tie. A shipper wants a ship on berth without fail, and the shipowner wants the goods without fail. There is a mutual benefit and a mutual obligation, and it should be possible to create this in such a method as to prevent irresponsible competition for berth cargo by tramps.

The Copeland-Bland Bill, which will probably be the basis for legislation at the coming session of Congress, provides in Section 1106 that the Authority shall have the power to permit members of conferences to agree in writing with shippers or receivers of freight in foreign trade, to return a stipulated part of the freight monies in consideration of the shipper or receiver confining his shipments to the conference. This legalizes the tie.

The possibility of a monopoly, however, brings about the necessity of some control. Now—as to the protection against unfair monopoly. Section 1105 of the same bill would permit the Authority to have its representative participating in all pools, conferences and associations. Section 15 of the Act of 1916 provides that no agreement can be entered into without the approval of the Shipping Board.

The Senate in emasculating the Copeland-Bland Bill struck out these provisions, and substituted nothing in their place. In other words, the Senate once again refuses to accept this universally recognized means of establishing an adequate merchant marine. The Commonwealth of Australia, the Union of South Africa, and the United States of America, are, I believe, the only three countries in the world prohibiting the deferred rebate. Great Britain, to whom our legislators so often turn for illustration of what they are attempting; Great

(*Continued on page 13*)

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* Abstract of paper presented at the American Merchant Marine Conference, New York, November 18, 1935.

† Vice-president, Moore and McCormack, Inc., New York.

Roper Urges Subsidy Legislation

By Harold F. Lane

Legislation to provide for the abolition of indirect subsidies for shipping and the substitution therefor of direct aids based on building and operating differentials is again recommended by Secretary Roper of the Department of Commerce in his annual report to Congress. Meanwhile a committee representing the Commerce and Postoffice Departments has been working in the effort to prepare a new bill for introduction at the coming session, based on a reconciliation between the different bills reported by the House and Senate last session, which it is hoped to have ready to submit to the President at an early date. The President has indicated that he wants a subsidy bill passed at this session and has given such a bill the most prominent place on his program for the session but there is still a great deal of conflict among the various interests that are working for it. The committee has been working under the direction of J. M. Johnson, Assistant Secretary of Commerce. General meetings were temporarily concluded on December 18 and each department planned to prepare its separate suggestions to be considered at another conference to be held in a week or so.

In the interest of the merchant marine the following legislation was recommended in the annual report:

(1) Abolition of indirect subsidies and the substitution therefor of direct aids based on building and operating differentials; (2) amendment of the Shipping Act, 1916, so as to provide (*a*) that tramp ships be included in the definition of common carriers; (*b*) that interstate carriers of coastwise traffic be required to file and observe their actual rates; (*c*) that the Department be clothed with minimum rate power over carriers, and minimum and maximum rate power over other persons subject to the act; (*d*) that false billing by shippers be made a misdemeanor; and (*e*) that specific penalties be provided for violations of the act; (3) repeal of the so-called Allin amendment provisions of the Intercoastal Shipping Act, 1933; (4) changes in the present laws relating to the division of damages in cases of collisions at sea; (5) appropriation of funds for a merchant marine naval reserve; (6) removal of the limitation of $185,000,000 on the amount of construction loans, and the granting of authority for the Department to build up the Construction Loan Fund until the amounts set aside for this purpose out of revenues from sales and operations, plus appropriations by Congress, reach the maximum of $250,000,000 provided by the Merchant Marine Act, 1928; (7) amendment of the coastwise laws substantially as provided in H. R. 112, Seventy-fourth Congress; (8) authority for the Department of Commerce to underwrite war risks in connection with American commerce in time of emergency; and (9) adoption of The Hague rules for the carriage of goods by sea.

In addition to the above, it is recommended that the International Convention for Safety of Life at Sea, signed in London in 1929, be ratified and given full effect at the next session of Congress.

As to legislation affecting the Bureau of Navigation and Steamboat Inspection the report said:

A number of measures already drafted for congressional consideration are of interest to this bureau. The measure known as the bureau's "reorganization" bill (H. R. 8599) is a consolidation of five bills drafted in the bureau. Its provisions include a suggestion of (1) change of name of the bureau, (2) reduction in the number of supervising inspectors and reorganization of that service, (3) provision for traveling inspectors and trial boards in case of accident, (4) creation of a bureau technical staff to supervise construction, (5) compensation for overtime services. Another bill which is a consolidation of two bills drafted by the bureau provides (1) an amendment to the Seamen's Act to permit an examination of seamen and (2) provision for maintaining discipline on shipboard through the issue of "certificates of service" to the crews. Another bill is intended to amend certain provisions of the Revised Statutes so as to extend the provision of the steamboat inspection laws to motor-propelled vessels. Among other legislation favored is a measure now in Congress intended to improve living conditions on small vessels and one providing for an 8-hour day for deck crews. All of these bills have been favorably reported from the House Committee on Merchant Marine and Fisheries and two have passed the House.

Legislation was also recommended relative to the marking of wrecks and reimbursement for expenses incurred, and payment for damages to aids to navigation. The report also urged two minor amendments to the act of May 28, 1935, affecting the disposition of lighthouse reservations.

Additional Safety Legislation Urged

A serious situation confronts the United States today with respect to safety at sea, according to a report presented at the National Accident Prevention Conference, called by Secretary Roper of the Department of Commerce, held at Washington on December 18, by the Committee on Accident Prevention. The report was presented by Walter Parker, of New Orleans, chairman.

"Despite repeated disasters and governmental investigations there still remains to be translated into effective action the necessary legislation to remedy these conditions," the committee said.

"This committee invites public attention to the fact that there exists for the sole purpose of safety of life and property at sea the Bureau of Navigation and Steamboat Inspection, in the Department of Commerce.

"The committee finds that this bureau has repeatedly recommended effective legislation to enable it to remedy or materially reduce the deficiencies that were definitely established by the various governmental investigations in the recent marine disasters. Thus far Congress has neglected to act.

"The committee feels that the greatest need at the present time is to properly acquaint the American people with the true state of affairs with a view to obtaining their support for the necessary legislation.

(1) To improve construction and maintenance standards,
(2) To improve ships' personnel,
(3) To improve operating methods,
(4) To improve governmental supervision and inspection.

"The committee concludes that the subject is so broad, and there is so much work to be done in this field of safety, that continuing effort and broader representation on the committee are necessary in order to carry into effect a more definite program. The committee proposes to enlarge its membership and hold further meetings, formulate a program in detail, and engage in an effective line of action."

Promotion of Safety in the Design and Construction of Vessels*

By David Arnott†

Recent passenger ship disasters, involving serious loss of life have again brought the subject of safety of life at sea prominently before the public, with the inevitable demand for still higher safety standards for ship construction and operation, despite the fact that of all the means of transportation available to the traveling public sea travel is the safest. This article reviews briefly the problems of the naval architect in providing for safety in the design and construction of ocean-going ships and gives some account of governmental and classification society rules with particular reference to such important safety considerations as freeboard, structural strength, subdivision arrangements, stability and fire protection

The problem of the naval architect is to design a floating structure to carry, with the highest practicable degree of safety, a definite weight of cargo, fuel, stores, etc., and a certain number of passengers, at a specified minimum speed on a certain maximum draft of water all with due regard to economy in costs of construction and operation in the hope that her owners will be able to make a profit over the useful life of the ship, without which expectation the ship will not be built. The naval architect has to comply with certain rules and regulations which materially affect the design, such as the U. S. tonnage regulations, and the corresponding regulations of the Panama and Suez Canal authorities where applicable, the Public Health Service regulations for rat proofing, etc., the Steamboat Inspection requirements, the load line regulations, and the construction rules of the American Bureau of Shipping or other classification society, the three latter being properly considered safety regulations.

The principal perils of the sea to which ships are subject are foundering through stress of weather, collision, stranding or grounding, and fire. It should be emphasized that abnormal weather conditions are to be anticipated as part of the service conditions of any ocean-going ship. Collision, stranding and fire are accidents which may never happen to a ship during her whole useful life, so that it is necessary to differentiate between essential safety considerations for normal operation, i.e., barring accidents, and provisions for the safety of life after a serious accident has happened to the ship, such as adequate life-saving appliances, the highest practicable standard of subdivision and proper facilities for detecting and extinguishing fire.

The primary concern of any government in merchant shipping is to protect the interests of the traveling public and the crew, so that it follows that all maritime countries lay down rules for safe navigation, efficient manning, the licensing of officers and promulgate standards for the subdivision of passenger ships, for fire protection and for life-saving appliances, etc. Despite certain handicaps, the Steamboat Inspection Service has done good work in the past, and it will be in the best interests of all concerned if Congress, through necessary legislation and appropriations, provides the director of this bureau with the means to reorganize and maintain his department at a high degree of efficiency and to pay his inspectors remuneration commensurate with their responsibilities.

The principal maritime nations have their own classification societies. In this country it is the American Bureau of Shipping. The growth and progress of this society since the World War is attested to by the position it has attained among classification societies, due to the confidence reposed in it by shipbuilders, shipowners and underwriters generally. The United States Government has indicated its approval of the American Bureau in the Merchant Marine Acts of 1916, 1920 and 1928, and again in the Load Line Acts of 1929 and 1935. The bureau as a classification society is primarily concerned in providing standards for the seaworthiness of ships and the reliability of their machinery, and while the work of the society parallels to some extent it does not conflict with the work of the Steamboat Inspection Service.

The best interests of safety for the American merchant marine will be furthered in my opinion by an increasing co-operation between the Steamboat Inspection Service and the American Bureau of Shipping.

International Conventions of 1929 and 1930

The first international conference to consider safety of life at sea was convened in London, in 1913, as a direct result of the *Titanic* disaster. A convention was signed but, owing to the World War, was never ratified, although several of the nations adopted part of its recommendations in their various national regulations. For example, the provisions relating to life-saving appliances were embodied in the Seaman's Act, and administered through the Steamboat Inspection Rules. The ice patrol in the North Atlantic, operated by the United States and financially supported by the principal nations, was one of the beneficial results of this convention.

It was not until 1929 that it was found possible to convene another international conference. Unanimous agreement was finally arrived at upon all matters included within the scope of the convention, and the safety convention has since been ratified by the principal maritime nations with the sole exception of the United States.

The United States was the last of the great maritime

* Abstract of paper read before the 24th Annual Safety Congress, Louisville, Ky., October 17, 1935.

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nations to enact a compulsory load line law, but the passing of the Load Line Act of March, 1929, applicable to sea-going ships in the foreign trade, paved the way for international agreement on this important subject. The International Load Line Convention held in London in 1930 was an essential corollary of the Safety Convention of the previous year. Agreement was reached on the various matters before the conference, and the convention has since been ratified by the various governments concerned, our own government being the first to ratify the Convention in April, 1931.

Safe Loading

The Department of Commerce Load Line Regulations, which are similar to the requirements of the Load Line Convention, besides giving formulas for calculating minimum freeboards, include certain conditions of assignment such as a minimum standard of structural strength and stipulate efficient means for closing hatches and other openings in the deck and sides. The Rules provide for surveys for renewal of load line certificates every four years, also for annual inspections to ensure that the means for closing openings are maintained in an efficient condition and that no change has taken place in the ship's structure which would affect the conditions under which the original freeboard was calculated. It should be emphasized that the load line requirements are based on the experience of many years of loading all types of merchant ships trading in all parts of the world. The Rules provide for different loadings for the various seasons of the year, and also permit of deeper loading than formerly for tankers, lumber carriers and other special types of ships, based largely on American practice.

In August, 1935, Congress enacted a supplementary load line law for vessels operating in the coastwise and intercoastal trades, thus eliminating the anomaly of a ship leaving New York for Havana being required to have a load line marked on her side, while a ship leaving New York for say San Francisco was exempt from the law. It is of interest to note that the new load line law will also apply to vessels engaged in Great Lakes service, but with the very essential proviso empowering the Secretary of Commerce to make departures from the provisions of the International Convention, which definitely exempted Great Lakes vessels and which can only be properly applied in their entirety to ocean-going ships. The act does stipulate, however, that the load lines of coastwise vessels are to be determined under the provisions of the international treaty.

To place a legal limit on loading which ensures that a ship will not be loaded in service beyond the maximum draft for which she was designed is not only a fundamental safety provision, but is in the best interests of the shipowners themselves, as it sets up a standard for commercial fair dealing as far as loading is concerned. It takes the question of overloading out of the courts as one of expert opinion, since any ship loading beyond her legal load line will be held to be overloaded, at least technically if not actually so, for the conditions prevailing on a particular voyage.

Structural Strength

To design a floating structure to be propelled through the water with varying loads and ever varying support, capable of withstanding the stresses to which the structure is subject under all conditions of wind and weather, is an important problem in the economics of ship design in respect that any excess weight of material over and above that required for structural efficiency with an adequate margin for corrosion reduces the deadweight carrying capacity by that amount. That the naval architect has a comparatively easy task in designing a safe structure is due largely to the work of the classification societies, whose rules are recognized by the various government authorities throughout the world as safe standards for the construction of ships and their machinery. In the past the classification societies have been sometimes criticised as being unduly conservative, but that is certainly not true today. The naval architect has plenty of scope to develop sound, scientific and economical structural design within the standards of modern classification rules.

Subdivision

How to divide a ship by transverse bulkheads into watertight compartments such that she will remain afloat in the event of her underwater hull being punctured constitutes an important problem for the naval architect. For a given ship this requires the determination of a floodable length, which varies from point to point along her length and depends on her form and load draft. It is obvious that the amount of water which can enter a hold will depend upon the volume of the space unoccupied by cargo and the capacity of the cargo itself to absorb water, which varies with different commodities, so that flooding calculations are essentially based on certain assumed average permeabilities, the convention standards being 63 percent for cargo spaces, 95 percent for passenger spaces, and 80 to 85 percent for machinery spaces, depending upon the type of machinery installed.

The desirability of a two-compartment standard is obvious, and it becomes important to know just why this should not be a minimum requirement for all sizes and classes of ships carrying passengers. The Safety Convention agreed on the general principle that all passenger ships should be subdivided as efficiently as possible "with due regard to the nature of the service for which they are intended," and the practicability of increasing the standard of subdivision as the length of the ship increases, also as the ship tends to depart from the ordinary cargo type, carrying comparatively few passengers, and approaches the highest class of passenger ship, carrying little or no cargo, was also duly recognized by the convention. Standard curves showing the required degree of subdivision were laid down for each of those extreme types and were associated with a method of determining the standard for intermediate types by means of a criterion of service numeral which had been the subject of considerable investigation since the 1914 Convention. Efficient and economical handling and stowage of general cargo requires large hatches in association with a reasonable length of hold, and fortunately the problem of making adequate provision for such an arrangement becomes easier as the length of the ship increases. In the smaller classes of ships of the ordinary cargo-passenger type it is not always practicable to obtain even a one-compartment standard throughout, and the Safety Convention recognized this fact by leaving it to the government concerned to endeavor to obtain at least a one-compartment standard in such ships wherever practicable, with due consideration for the operating requirements of each individual case.

It should be recognized that the convention deals primarily with ocean going ships engaged in international voyages. There are, however, ships engaged in coastwise and special trades operating in crowded waters where a higher standard of subdivision than required by the convention is not only highly desirable but fortunately quite practicable, especially in those cases where the bulk of the cargo and passengers are carried above the bulkhead deck. Such types, together with ferries and ex-

cursion boats, which carry large numbers of unberthed passengers, should receive special consideration by the administration, with a view to the highest practicable standard of subdivision being adopted in each individual case of new construction.

It is, of course, useless to provide for a high standard of subdivision, if watertight doors in bulkheads and airports in the ship's side below the bulkhead deck are going to be left open or cannot be closed properly after a serious accident. Openings in the bulkheads and the sides of ships are a potential danger and every endeavor should be made to keep their number down to a minimum if safety is to be a primary consideration in design.

Stability

Stability is that property of a ship which makes her return to the upright position after heeling over in a seaway. So far no maritime country has considered it necessary to lay down definite regulations governing stability, although the Steamboat Inspection Service for some years past has required every new or converted passenger ship to be inclined prior to entering service, and since the convention this is also a requirement of the other maritime countries. There are wide differences of opinion among naval architects as to what constitutes a satisfactory measure of stability for a particular type of ship and service in terms of metacentric height, but experience has shown that a tender ship with the lowest metacentric height compatible with safety is more likely to be comfortable at sea and generally more seaworthy than a stiff ship having a high metacentric height.

To investigate in a new design the amount of transverse stability in any likely damaged condition is extremely important from the point of view of safety after an accident, but to require an excessively high standard for stability, based on some assumed condition which may never occur during the whole life of the ship, might easily result in excessively dangerous rolling in normal operating condition. The problem is one for careful investigation by the proper government authority on the merits of each individual case rather than the setting up of definite stability standards for all classes of passenger ships which might easily handicap sound design.

Fire Protection, Detection and Extinguishing

Fires in cargo holds, which are fairly common, do not usually involve the loss of the ship or of life, since hold fires can be confined and controlled by the closing of ventilators and other openings and the use of steam or gas smothering. An outbreak of fire in the superstructure of large passenger ships, however, is a much more serious matter on account of the large amount of combustible material in passenger spaces and the difficulty of controlling the fire unless immediately detected. The Safety Convention requires, in addition to the water main system, detection and alarm systems in the passenger quarters, the provision of special extinguishing apparatus in oil-burning vessels and fire-resisting screen bulkheads to prevent the spread of fire in the superstructure. The convention laid great stress, however, on the maintenance of an efficient patrol system, and there is no doubt that this will continue to be of primary importance despite the installation of alarm and detecting systems.

The major fire losses at sea since the Safety Convention emphasize the necessity for the use of fire-retarding materials in construction to the utmost practicable extent, since experience has shown that once out of control, fires in passenger quarters spread with alarming and dangerous rapidity. The solution of the problem lies in improved construction in an endeavor to confine the fire to the particular space where it originated and where it can be readily extinguished. It is along such sound lines that future progress towards the elimination of serious fires at sea may confidently be anticipated.

General Remarks

In the design and operation of merchant ships the question of economics must necessarily be a primary consideration. American shipping in the foreign trade has to meet world-wide competition, and is already badly handicapped by relatively high construction and operating costs as compared with foreign countries. One sure way of legislating shipping out of business would be the setting up on the plea of safety of unreasonably high legal standards which might materially affect potential earning capacity and ruin the ship as an economic unit.

A ship cannot be made fool proof, and the provision of safety will be best served by doing everything possible to prevent accidents from happening. In view of the fact that ships and their machinery are becoming more and more complicated and require for their safe operation skilled officers and engineers who really know their own ship, the desirability of requiring higher standards in future for examination of ship's personnel is worthy of consideration by the proper government authority. I would like to see candidates examined on their knowledge of major sea disasters, as nothing would develop a keener sense of personal responsibility for safety on the part not only of ship's personnel but also of all concerned with the building and supervision of ships than a study of the official records of such accidents.

Fouling of Ships' Bottoms

Speaking on the subject of the fouling of ships' bottoms at the summer meeting of the Schiffbautechnische Gesellschaft, at Hamburg, Dr. Kühl referred particularly to the results of researches carried out at the Hamburg Shipbuilding Research Station, Cuxhaven, according to *Shipbuilding and Shipping Record*. In this matter, he said, it was very much a case of prevention being better than cure, for while the larvae or embryos of marine organisms are too small to be removed effectively by any mechanical means applicable to ships' bottoms, the adult organisms are much more resistant to attack and their forcible removal results in damage to the protective coating of the submerged plates. Attempts to use alternating-current electricity have failed because the high conductivity of sea water restricts the effective range of the electric field to a small area of plate in the immediate neighborhood of the electrodes. There remains only the use of an inhibitory coating. Metals and metallic compounds offer advantages, but research is required, and is proceeding, concerning the effects of such constituents on each other and on the medium supporting them. Chemical and electrolytic actions have to be considered; copper and certain other metals lose their protective effect if they come in contact with iron in sea water, and some varnishes obstruct, while others assist the protective action. Among the methods now engaging special attention there is the use of sprayed coatings of metals amenable to this process of application. No very satisfactory results appear to have been obtained with coatings of rubber and similar materials, but Dr. Kühl considers that prospects are perhaps better for the use of cellophane or acetyl cellulose coatings impregnated with metallic poisons.

Cleveland Cliffs steamship Michigan, unloading coal at Escanaba pockets

Are New Ships Needed on the Great Lakes?

By A. H. Jansson

Time and the elements have little effect on the soundness of the structure of vessels on the Great Lakes. Boilers do have to be renewed after a span of years and the machinery must be given some attention to offset the wear and tear of service to maintain it in good running condition, and there are various other maintenance and repair items such as renewal of tank tops, side tank bulkheads, etc., but the hulls with minimum care in upkeep will last indefinitely; no one seems to know how long, perhaps 50 years and maybe longer.

With ample existing tonnage, which easily moved the all time record volume of bulk freight in 1929, are there, therefore, any reasonable prospects for new shipbuilding? The superficial answer is an emphatic *no* and appended to it is the query, why build new ships when there is ample tonnage which can still be operated? A more careful analysis, however, will show that new ships must be built as replacements of many older inefficient units now obsolescent because of their size, arrangement, operating expense, and because to keep them running is like using a dull and makeshift tool when there is at hand, at a cost to be sure, a fine new modern tool designed for maximum performance and special suitability for the work to be done.

In the American merchant fleet on the Great Lakes, 324 vessels, with a total carrying capacity of 2,711,300 long tons on a draft of 19 feet, are currently listed as ore carriers. Of this fleet, 15 are non-propelled barges of 87,000 tons carrying capacity. The vessels of this fleet were designed and constructed in accordance with the experience of their time for maximum efficiency as ore carriers. To attain this objective a number of factors had to be considered, among which are:

1. An extremely full form, sacrificing speed and using more power, in order to carry maximum weight of ore on the draft permissible up to the full load draft of the vessel.
2. Heavy construction assuring ample strength in fully loaded condition and in all kinds of weather.
3. Location of machinery aft and bridge and pilot house in the extreme forward end to avoid interruption in a clear sweep fore and aft for access to all cargo spaces.
4. Number, location and size of hatches to facilitate loading and unloading.
5. Principal dimensions, length, beam and depth and their relations to each other affected by considerations other than those purely of design such as restrictions necessarily imposed by the waterways and locks through which the vessels must operate and the size and arrangement of unloading docks.

Besides ore, there are other important bulk cargoes to

be moved such as coal, grain and stone, for which the ore carriers are generally suitable. In addition to the ore carriers there are other vessels, not suitable for carrying ore, or grain, serving these trades, particularly the self-unloaders for carrying stone and coal. It is probably true, however, that in the past, ore requirements have been the basic factor in determining the capacity of the bulk cargo fleet.

No concerted or co-ordinated plan was ever developed to maintain a reasonable relation between the aggregate capacity of the ore carrier fleet and the volume of ore to be moved. Each vessel owner, whether big or small, a subsidiary of some large company or independent, expanded his fleet to meet the needs of his prospects or assurance of employment. When new vessels were added it was with a definite anticipation of their use in the ore carrying trade. Any new vessel contemplated simply had to be primarily suitable for carrying ore, and, of course, incidentally available for coal, grain and stone.

Since the coal movement is entirely upbound, it can readily be taken care of by the active ore-carrying fleet, which in anything like a normal year will be of nearly twice the capacity required for coal. Thus, except for the steadily increasing use of self-unloading vessels which have the advantage of being able to deliver their cargo to any point with sufficient depth of water, not being dependent on dock equipment for unloading, the carrying of coal may be said to be incidental and complementary to the ore movement.

The situation with respect to grain and stone is different in that grain moves entirely downbound (with the exception of comparatively small quantities of foreign grain) and stone also moves downbound, including lower Lake Michigan ports, to the extent of perhaps 95 percent. The combined movement of grain and stone in a normal year (in 1930 it was 22,283,857 short tons) will require the use of considerable tonnage, but in such times the ore-carrying fleet, not being fully occupied, has been of ample capacity to meet all demands. It must also be remembered that the self-unloader, which is not included in the number and carrying capacity of the fleet under consideration, is now an important factor in the stone trade probably moving as much as 33 percent of the volume. Boats outside of the so-called ore-carrying fleet are also available to some extent in carrying grain and coal, all of which eases the demand on the ore-carrying fleet.

From past performance it appears self-evident that the great fleet of 324 American vessels listed as ore carriers and also available for the coal, grain and stone trades is of considerably greater capacity than is needed for normal requirements; that only in such an exceptional year as 1929 when 65,204,600 long tons of ore were moved and the total of all of the principal bulk commodities reached the all time high of 138,574,441 short tons, could the existing fleet hope to be operated at the virtual limit of its capacity.

Removing ore at Lake Front Docks, Cleveland

Wilson Transit steamer William C. Atwater in the Detroit River with cargo of iron ore

Not only what appears to be over capacity of vessel tonnage for immediate and future requirements of the trade but the fact, already referred to, that in the fresh water of the lakes there is very little deterioration of the hull structure would seem to make any prospects of new shipbuilding depend upon other factors. Regardless of ample capacity of existing tonnage and the excellent state of preservation of the hull structure of vessels of 30 and 35 years and older, the pressure of economical operation will in due course make new shipbuilding for this trade necessary.

Before considering the factors of economical operation which will in time make it necessary either to scrap or convert to other employment a considerable number of existing ore carriers and to replace them with tonnage of modern design, it will be of interest to survey briefly the records of the movement of bulk commodities in past years. For convenience, this movement during the past 15 years is segregated into two periods; the past five years covering the period of the depression and the ten preceding years beginning with the previous depression year of 1921. The average yearly ore movement in the five years 1931-1935 was only 19,854,327 long tons or 22,236,846 short tons, (for the season of 1935 it was 31,765,852 short tons) while the average yearly ore movement for the ten preceding years beginning with 1921 and ending with 1930 was 49,606,892 long tons or 55,559,720 short tons.

The yearly averages of the combined total tonnage of ore, coal, grain and stone for the same respective periods were 69,100,000 short tons (estimated) and 111,077,783 short tons (actual). Assuming that self-unloaders and other bulk vessels not included in the fleet of ore carriers have an aggregate capacity of 10 percent of the ore fleet and further assuming that the same ratio applies to the employment of the two categories, the ore-carrier fleet was called upon to move an average of 62,190,000 short tons per year during the past five years and an average of 99,970,005 short tons per year during the ten preceding years beginning with 1921 and ending with 1930.

It is believed that the latter figure, of about 100,000,000 tons, represents normal operation for the immediate future. Let us now see how far the capacity of the ore-carrier fleet will be occupied in moving this tonnage. On a draft of 19 feet its total carrying capacity for one trip is 2,711,300 long tons, or 3,036,656 short tons. To move this amount of cargo it would, therefore, require an average of 33 one way trips for every unit of the fleet during the season of navigation, which, if reckoned at 225 days, would work out at an elapsed time of 6.8 days for each trip. Figuring four days for each one-way trip, and this may be somewhat high considering the number of shorter trips, such a movement would employ 58.8 percent of the total maximum ore-carrier fleet capacity. In practice such a movement would mean the full employment of the more economical units and the lay-up or partial employment of other units.

When complete cargoes are available, which is usually the case, though there are exceptions where a small quantity may be specified, and also where a smaller vessel must be used because of restrictions in the waterway on which the unloading dock is located, it is obvious that the net revenue to the operator will be much greater per trip of a vessel carrying say 11,000 tons than one carrying 8000 tons since the increase in operating expense in crew and fuel, etc., for the larger vessel will represent but a small fraction of the increased revenue. This difference in revenue between the large and small carrier would, other considerations being equal, make it almost prohibitive to operate the still smaller vessels of say below 8000 tons capacity, unless forced to do so because there are not enough of the larger vessels available or to meet special requirements.

How many smaller vessels are there in this fleet of 324 ore carriers? The records show that 155 vessels of the fleet range in capacity from 8300 long tons to 3500 tons, with a combined total carrying capacity of 1,120,224 short tons. This number may be further broken down into the following classifications according to carrying capacity: 18 of 8200 to 8000 tons; 33 of 7800 to 7000 tons; 51 of 6900 to 6000 tons; 48 of 5900 to 5000 tons; 4 of 4600 to 4000 tons and one of 3500 tons.

If the smaller units, enumerated above, are subtracted from the list, there are left 169 vessels of 1,711,100 long tons or 1,916,432 short tons capacity. This number may be broken down in accordance to range of capacity as follows: 89 vessels of from 8400 to 9900 long tons capacity; 73 ranging in capacity from 10,000 to 11,500 long tons; 6 vessels of from 11,600 to 12,500 long tons; and 1 vessel of 13,000 long tons.

On a 19-foot draft, the larger vessels of the fleet, that is, the 169 units of 8400 tons capacity and up, represent 63.1 percent of the total trip capacity of the fleet. From the calculations given above it would appear that this portion of the fleet, working at about maximum capacity, could move the bulk tonnage in a normal year. From a practical point of view, this would be counting much too closely and it would not provide that degree of flexibility and leeway in meeting the demand for smaller cargoes in special instances. For practical purposes it would probably be necessary to have an efficient, well co-ordinated fleet, which, under normal conditions, would not be called upon to operate at over 70 percent of its maximum capacity.

The largest and most elaborate bulk freighter in the fleet is the *Harry Coulby,* owned by the Interlake Steamship Company, Pickands, Mather & Company, Cleveland. This vessel was built at the Lorain, O., yard of The American Ship Building Company and was completed in September, 1927.

Principal characteristics of the *Coulby* are: Length overall, 630 feet 9 inches; length between perpendiculars, 607 feet; breadth molded, 65 feet; depth molded, 33 feet; draft loaded, 20 feet; displacement loaded, 21,380 tons of 2000 pounds each; gross tonnage, 10,179; net tonnage, 8145; deadweight capacity, at 20 feet, 14,000 long tons; cargo capacity, nominal, 14,000 short tons; cargo capacity in cubic feet, 589,257; bunker coal capacity in tons, 521; speed, 12¾ statute miles per hour.

The propelling machinery consists of one, triple expansion, reciprocating steam engine built by The American Ship Building Company. The cylinder diameters are 25 by 41 by 67 inches, and the stroke is 42 inches. This engine develops 2500 indicated horsepower at about 87 revolutions per minute. Steam is supplied by three, Babcock & Wilcox Company marine, watertube boilers, having a combined total heating surface of 9345 square feet; total superheating surface, 750 square feet; and total grate surface, 191 square feet. The working pressure is 215 pounds per square inch and coal is used.

In addition to the *Harry Coulby,* the following 600-foot bulk freighters were completed in 1927: *A. F. Harvey* and *B. F. Affleck,* for the Pittsburgh Steamship Company; *Wm. McLauchlan* and *Robert Hobson,* for the Interlake Steamship Company; *George M. Humphrey,* for the Kinsman Transit Company; and the *L. E. Block,* for the Inland Steamship Company. The last new vessels added to the fleet are: the *Horace Johnson* and *Wm. G. Clyde,* completed in 1929; and the *Eugene P. Thomas* and *Thomas W. Lamont,* completed in 1930, all four for the Pittsburgh Steamship Company.

When additions and replacements are made to the ore-

One of seventy-two vessels which comprise Pittsburgh Steamship Company fleet

carrier fleet, as they are bound to be, now that industrial operations are approaching normal and are beginning to prepare for the next period of expansion, the smaller bulk carriers, it is likely, will be the first to be displaced by a less number of larger and more efficient modern units. It will still be necessary, of course, to have a sufficient number of smaller vessels for the special requirements mentioned above. Carrying capacity will become increasingly more important with the completion of the deepening of the channels to permit a maximum draft of 24 feet. As far as the principal channels are concerned, this work will be completed, it is understood, in 1936, but it will probably be a year or two later, maybe longer, before full advantage can be taken of this depth, because of the work which still remains to be done in deepening the harbors and dock approaches.

To make full use of the deeper channels and to take advantage of recent engineering progress, the vessel owners should begin now to give careful consideration to the design of new ships, in order to increase efficiency of operation and by so doing increase earnings. There are many conditions peculiar to this trade which must be given full consideration in adapting the notable advances in marine engineering and naval architecture of recent years. It does not seem reasonable to suppose that new ships will not be built for the bulk freighter fleet on the Great Lakes incorporating engineering features that will make them most practicable for this service.

In a following article or articles we expect to consider in more detail those characteristics of the ore-carrier fleet which have a bearing on the need of new ships, such as age, size, arrangement, speed, machinery, etc., and to discuss possible improvements in design.

Rationalizing American Merchant Shipping

(*Continued from page 5*)

Britain, which stands pre-eminent on the ocean with its merchant marine, has used the conference and deferred rebate system for a little over fifty years. It is still using it, and shows no signs of wavering in its allegiance.

A one-sided contract has always proven to be a useless contract. To tie the ships and leave the shippers wholly free is one-sided and unfair, and can produce no good results. The record proves this. I do not maintain that deferred rebates are the only ties. I do maintain that they are the most effective ties. They are the most beneficial to ships and shippers and require the least governmental interference. If they are wholly obnoxious, other means can be, and must be devised, if conferences are to survive. If the Congress is to destroy the possibilities of the deferred rebate they must be required to provide some other tie.

The Senate of the United States in considering the Copeland-Bland Bill struck out the deferred rebate clause. No bill must be permitted to pass with this clause stricken out and no other conference protection provided. If it is permitted, such an act will prove only another delusion and a snare, another futile gesture. Under the best of circumstances the bill as passed by the House would have created a merchant marine only through a long and difficult process.

House Bill 8555, and probably any bill that is likely to pass, specifically provides that government assistance shall only equal the burdens of expense placed upon a ship by virtue of her American registry. Not the slightest advantage is given us and nothing is done about the many indirect handicaps that have been piled upon American ships. The amount of new construction under the new bill may prove a surprising disappointment. Unless there are no unfair strings tied to profits; unless easily available money is provided; and, unless there is good protection for whatever money is invested; there will be no building by wise shipping men.

Shipping of the entire world needs rationalization—needs regulation. The silly waste that is going on now, which is largely being paid for by taxpayers and which in the United States will be wholly paid for by taxpayers, should be controlled and stopped. Opposition to the deferred rebate comes from the uninformed or from the sinisterly selfish.

The Congress of the United States has labored long and earnestly in an endeavor to give America a merchant marine. The failure has not been from lack of effort or patriotism. Congress seems close to a solution. Convince them that if they put American shipping on an even keel by absorbing the unnatural costs with construction and operating subsidies; provide decent means of self-preservation by legalizing combinations, conferences, and rebates; restore the sanctity of government contracts; and convince foreign shipowners and foreign nations that America is on the seas to stay for the purpose of carrying one-half of her commerce—do this and there will soon be flying from every masthead America's historical —"Don't Give Up the Ship."

Shipbuilding Increases 64 Percent

Returns compiled by *Marine Engineering and Shipping Review* show that the volume of shipbuilding in the United States increased over 64 percent in 1935. The volume of merchant tonnage under construction increased 257 percent and of naval tonnage 23 percent during the year. The output of American yards in 1935, totaling 122,313 tons, was the smallest recorded since 1908, and represents a decrease of 16.3 percent as compared with the output in 1934. Contracts awarded for the construction of new merchant vessels in December, totaled approximately $27,000,000

During 1935 the volume of shipbuilding in the United States increased over 64 percent. The vessel tonnage now under construction amounts to 459,671 tons, which exceeds that under construction in any year since 1923 except in 1930 when the shipbuilding program following the passage of the Jones-White bill was at its peak.

The shipbuilding industry starts the new year with a strong feeling of optimism as regards the prospects for future business. Orders for new vessels placed during the last four months have increased the volume of merchant tonnage under construction 257 percent and of naval tonnage 23 percent. This is looked upon as only the beginning of a substantial program of ship construction, which is necessary for the replacement of obsolete vessels as well as for upbuilding the merchant marine.

Outstanding Developments

The outstanding developments in merchant shipbuilding occurred during the last three weeks of the year when the United States Lines ordered a 23,000-ton transatlantic liner from the Newport News Shipbuilding and Dry Dock Company, the Socony-Vacuum Oil Company ordered two 15,000-ton tankers from the Sun Shipbuilding and Dry Dock Company; the Pan American Petroleum Corporation ordered two 15,000-ton tankers from the Sun Shipbuilding & Dry Dock Company and two 12,000-ton tankers from the Federal Shipbuilding & Dry Dock Company, and the Department of Plant and Structures of New York City ordered three 251-foot ferryboats from the United Dry Docks, Inc.

In contrast with the situation a year ago when only 18 percent of the work in hand was merchant work and 82 percent was naval work, merchant shipbuilding now comprises 38 percent of the tonnage under construction as against 62 percent of naval work.

Naval Construction

In addition to the 86 naval vessels, aggregating 283,851 tons, now under construction for the Navy Department, there must be built in the future, to bring the Navy up to Treaty strength, 36 destroyers and 18 submarines, or about 77,400 tons. In another year 7 of the 15 existing battleships will become over-age and can be replaced. In addition, Congress will be asked to authorize a number of auxiliary vessels for the Navy and transports for the War Department.

The United States Coast Guard has under way a shipbuilding program which will cost $18,446,000. This includes 78 vessels for varied duties in the Coast Guard fleet and at air stations and a large number of surf boats and lifeboats for shore stations.

Output in 1935

The output of American shipyards, which has been steadily diminishing in volume for the last five years, reached a new low figure in 1935 when 368 merchant vessels of 113,313 gross tons and six naval vessels of 9000 tons displacement were delivered. This represents a decrease of 16.3 percent as compared with the output in 1934 and is the smallest tonnage produced by the shipbuilding industry in any year during the last thirty years with the exception of 1908 when the total output was less than 50,000 tons.

Forty-six shipyards report the delivery in 1935 of 368 merchant vessels of 113,313 gross tons and six naval vessels of 9000 tons displacement. Thirty-five of the yards report 131 merchant vessels of 175,820 gross tons and 86 naval vessels of 283,851 tons displacement now under construction for future delivery.

The 46 shipyards which delivered vessels in 1935 compare with 35 in 1934, 22 in 1933, 45 in 1932, 69 in 1931 and 76 in 1930. The 35 yards reporting orders for new ships at the end of 1935 compare with 30 in 1934, 27 in 1933, 24 in 1932, 38 in 1931 and 41 in 1930.

Of the merchant vessels built in 1935, when figured on a basis of gross tonnage, 18.4 percent were steamships, 5.3 percent were motorships, and the remaining 76.3 percent were barges or other non-propelled craft. Of the merchant vessels now under construction, 74.5 percent are steamships, 1.7 percent are motorships, and 23.8 percent are barges or other non-propelled vessels. All of the naval vessels built in 1935 were steamships, while of the naval vessels now under construction, when figured on a basis of displacement tonnage, 93.5 percent are steam propelled and 6.5 percent by oil engines.

Geographical Distribution

Of the vessel tonnage, both merchant and naval, produced in 1935, western river yards built 63 percent; Atlantic Coast yards, 32.2 percent; Pacific Coast yards, 4.4 percent; and Great Lakes yards, 0.4 percent. Atlantic Coast yards are building 87 percent of the tonnage now under construction; western river yards, 8.7 percent; and Pacific Coast yards, 4.3 percent. There are no new vessels at present under construction on the Great Lakes.

The only sea-going merchant vessels delivered during 1935 were two 15,000-ton tankers built by the New York Shipbuilding Corporation for the Socony-Vacuum Oil Company. The naval vessels completed during the year included six 1500-ton destroyers as follows: The *Worden* on March 1 at the Puget Sound Navy Yard; the *Aylwin* on May 1 at the Philadelphia Navy Yard; the *Hull* on May 24 and the *Dale* on July 19 at the New York Navy Yard, and the *McDonough* on June 28 and the *Monaghan* on August 30 at the Boston Navy Yard.

Table 1.—Merchant Vessels Completed in 1935

	Number of Vessels	Total Gross Tonnage	Total Horse-power
Steamships	6	20,854	11,000
Motorships	57	5,964	12,895
Non-propelled	305	86,495	......
Total	368	113,313	23,895

Table 2.—Merchant Vessels Now Under Construction

	Number of Vessels	Total Gross Tonnage	Total Horse-power
Steamships	25	130,829	136,300
Motorships	15	2,986	10,165
Non-propelled	91	42,005	......
Total	131	175,820	146,465

Table 3.—Steamships Built in 1935

	Number of Vessels	Total Gross Tonnage	Total Horse-power
Dravo Contracting Company	1	400	800
Lake Union Dry Dock & Machine Works	1	502	400
New York Shipbuilding Corp.	2	19,024	8,000
Pusey & Jones Corp.	1	736	1,500
Todd Shipyards Corp. (Robins Dry Dock)	1	192	300
Total	6	20,854	11,000

Table 4.—Motorships Built in 1935

	Number of Vessels	Total Gross Tonnage	Total Horse-power
Alabama Dry Dock & Shipbuilding Co.	2	200	200
Ira S. Bushey & Sons, Inc.	4	595	1,315
Calumet Shipyard & Dry Dock Company	1	10	50
Campbell Machine Company	3	950	1,090
Charleston Dry Dock Company	1	494	400
Charleston Navy Yard	1	290	800
Dubuque Boat & Boiler Works	4	200	625
Dravo Contracting Company	1	187	240
Harbor Boat Building Company	4	450	800
Jakobson & Peterson, Inc.	4	112	300
Kaw Point Boat & Motor Company	10	240	1,060
Manitowoc Shipbuilding Company	1	500	450
Marietta Manufacturing Company	1	726	1,300
Norfolk Shipbuilding & Dry Dock Company	1	224	200
Pennsylvania Shipyards, Inc.	3	200	730
St. Louis Shipbuilding & Steel Company	8	......	1,920
Spedden Shipbuilding Company, Inc.	2	80	330
United Dry Docks, Inc.	1	67	100
Western Boat Building Company	4	364	710
Winslow Marine Railway & Shipbuilding Company, Inc.	1	75	275
Total	57	5,964	12,895

Table 5.—Non-Propelled Vessels Built in 1935

	No. of Vessels	Total Gross Tonnage
Alabama Dry Dock & Shipbuilding Company	8	1,439
American Bridge Company	10	6,609
Bethlehem Shipbuilding Corporation, Ltd.		
Sparrows Point Plant	1	160
Union Plant	1	650
Dravo Contracting Company	33	14,852
Ellicott Machine Corporation	1	900
J. W. Evans & Sons	1	410
Ingalls Iron Works Company	23	7,000
Jakobson & Peterson, Inc.	3	500
Jones & Laughlin Steel Corporation	7	2,405
Marietta Manufacturing Company	13	4,155
John H. Mathis Company	2	1,605
McClintic-Marshall Corporation	37	12,399
Midland Barge Company	40	13,220
Nashville Bridge Company	20	4,000
Pennsylvania Shipyards, Inc.	14	3,600
St. Louis Shipbuilding & Steel Company	83	10,541
United Dry Docks, Inc.	5	1,105
Winslow Marine Railway & Shipbuilding Company, Inc.	3	945
Total	305	86,495

Table 6.—Steamships Now Under Construction

	Number of Vessels	Total Gross Tonnage	Total Horse-power
Charleston Navy Yard	1	2,000	7,000
Federal Shipbuilding & Dry Dock Company	4	30,760	12,000
Nashville Bridge Company	1	1,000	5,000
New York Navy Yard	2	4,000	14,000
Newport News Shipbuilding & Dry Dock Company	1	23,000	30,000
Philadelphia Navy Yard	4	8,000	28,000
Pusey & Jones Corporation	1	700	600
Sun Shipbuilding & Dry Dock Company	8	55,234	26,500
United Dry Docks, Inc.	3	6,135	13,200
Total	25	130,829	136,300

Table 7.—Motorships Now Under Construction

	Number of Vessels	Total Gross Tonnage	Total Horse-power
Ira S. Bushey & Sons, Inc.	2	180	800
Campbell Machine Company	1	50	115
Defoe Boat & Motor Works	1	120	250
Dravo Contracting Company	1	91	150
Harbor Boat Building Company	4	200	6,400
Ingalls Iron Works Company	1	1,600	1,000
Jakobson & Peterson, Inc.	2	40	120
Lake Washington Shipyards	1	265	550
St. Louis Shipbuilding & Steel Company	1	......	300
Western Boat Building Company	1	440	480
Total	15	2,986	10,165

Table 8.—Non-Propelled Vessels Now Under Construction

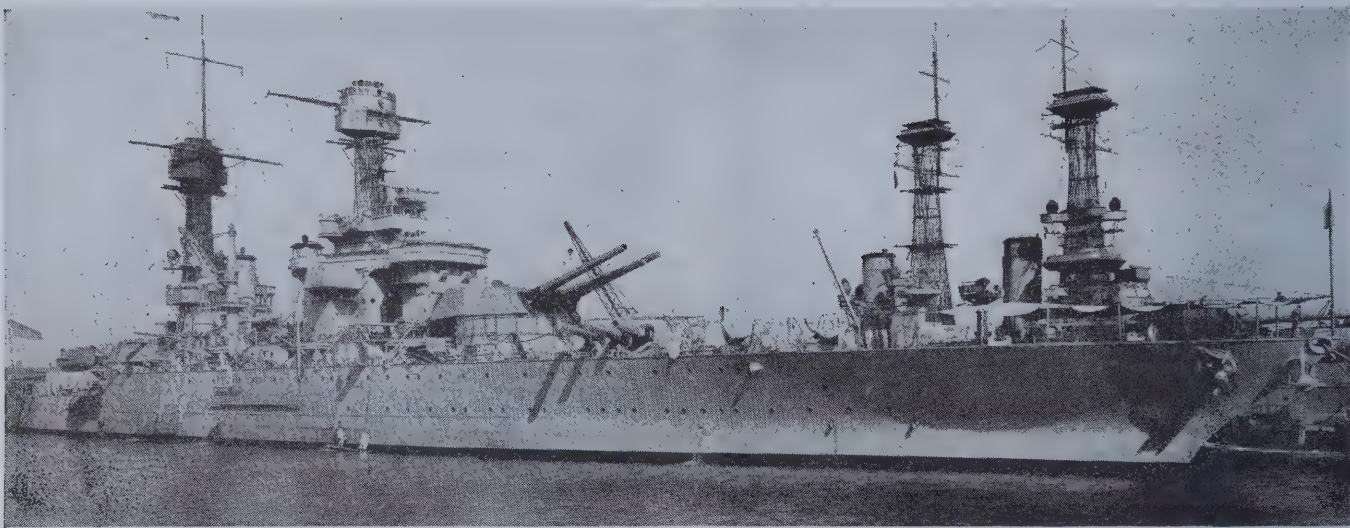
	No. of Vessels	Total Gross Tonnage
Alabama Dry Dock & Shipbuilding Company	3	836
American Bridge Company	29	20,387
Bethlehem Shipbuilding Corporation, Ltd., (Union Plant)	1	500
Commercial Iron Works	2	540
Dravo Contracting Company	19	10,032
Ingalls Iron Works Company	5	600
John H. Mathis Company	2	1,612
McClintic-Marshall Corporation	5	2,920
Nashville Bridge Company	8	1,600
Pennsylvania Shipyards, Inc.	1	400
St. Louis Shipbuilding & Steel Company	14	1,778
United Dry Docks, Inc.	2	800
Total	91	42,005

Table 9.—Naval Vessels Built in 1935

	No. of Vessels	Total Displacement Tonnage
Boston Navy Yard	2	3,000
New York Navy Yard	2	3,000
Philadelphia Navy Yard	1	1,500
Puget Sound Navy Yard	1	1,500
Total	6	9,000

Table 10.—Naval Vessels Now Under Construction

	No. of Vessels	Total Displacement Tonnage
Bath Iron Works Corporation	5	8,550
Bethlehem Shipbuilding Corporation, Ltd.		
(Fore River Plant)	9	45,100
(Union Plant)	2	3,000
Boston Navy Yard	6	9,000
Charleston Navy Yard	2	3,500
Electric Boat Company	8	10,522
Federal Shipbuilding & Dry Dock Company	7	11,200
Mare Island Navy Yard	5	7,279
Newport News Shipbuilding & Dry Dock Company	4	60,000
New York Navy Yard	4	32,000
New York Shipbuilding Corporation	7	37,400
Norfolk Navy Yard	7	10,500
Philadelphia Navy Yard	5	24,500
Portsmouth Navy Yard	6	7,800
Puget Sound Navy Yard	5	7,500
United Dry Docks, Inc.	4	6,000
Total	86	283,851



U. S. S. Tennessee, outstanding electric drive naval vessel

Fiftieth Anniversary of Westinghouse

Marine Developments

The year 1936 is to be a Golden Jubilee year for Westinghouse. It represents the 50th Anniversary of the founding of that company by George Westinghouse. Specifically January 8 represents the 50th Anniversary of the granting of the charter to the Westinghouse Electric Company.

In commemoration of its 50th birthday, Westinghouse on the night of January 8 will hold a tremendous "family" gathering in Pittsburgh for the 12,000 employes in that district. Simultaneously a similar meeting of Westinghouse employes will be held in every important Westinghouse factory and office in the country.

A unique feature of this gathering of 40,000 employes is that the complete Pittsburgh program will be broadcast to all of the other meetings in plants and districts over Westinghouse's own short wave transmitter at W8XK.

At Pittsburgh the meeting will be addressed by Chairman A. W. Robertson, President F. A. Merrick and others. These speakers will review the important contributions that Westinghouse has made to the progress of industry and to the welfare of humanity and present a forecast of the future of the electrical industry.

The marine branch Westinghouse activities had its inception in 1904, when George Westinghouse, realizing

Steamship President Coolidge, one of the two largest liners ever built in America

the limitations of the steam turbine for direct propeller drive, decided to find a practical method of utilizing this efficient prime mover. The Westinghouse turbine, of the modified and improved Parsons type, had been used successfully in land service since 1899. Well aware of the problems involved in adopting it for marine service, Mr. Westinghouse wisely engaged Rear-Admiral Melville and John H. MacAlpine to make a thorough study of the subject, with the result that in 1909 the mechanical engineering world was startled by the development of a ship propulsion gear unit that could transmit 6000 horsepower with an efficiency of more than 98 percent.

Because of space limitations, only a few of the many Westinghouse contributions to the American Merchant Marine can be touched on.

Geared-Turbine Propulsion. Since 1909, the Westinghouse Company has carried on research work on turbines and gears for ship propulsion, resulting in the introduction of numerous improvements in design and construction and installations totaling well over 2,000,000 shaft horsepower.

Electric Propulsion. For electric propulsion in combination with the Diesel engine, necessary modifications were made in direct-current generators and motors, to make them suitable for marine application. Then the variable voltage control system was adopted so as to form an exceedingly simple and reliable control.

For turbine electric propulsion, necessary changes were made in the design of land turbines, generators and motors to render them suitable for marine service.

Special Design Low-Pressure Turbine Geared to Reciprocating Engine. This arrangement, utilizing the exhaust steam from the engine in the low-pressure turbine, provides increased propulsion power and ship speed with no additional fuel.

High Efficiency Light-Weight Turbine-Generator Sets. Modern methods have made possible the production of a line of sets having only about half the weight of former designs, and still the units are of very much higher efficiency.

Electric Auxiliaries. Great advancement has been made in the development and improvement of motors and controllers for ship's auxiliaries.

Oil Governor. The oil type governor has proven to be an excellent adjunct to the marine turbine.

Improved Turbine Blades. The constant research work on turbine blades carried out for land machines has greatly benefited the marine turbine, as great strides have been made in this field.

Coast Guard Cutter Chelan, equipped with Westinghouse propulsion

Improved Steam Jet Air Ejector. This development has provided an extremely efficient and simple means of air removal with saving in space and weight.

Propeller Type Blower. This new blower is of very high efficiency and saves weight and space. The largest units were first used in land installations.

Propeller Type Pump. This was a companion development to that of the blower and the device has similar advantages.

High-Pressure Steam Developments. The ever broadening use of higher steam pressures in land stations has resulted in a gradual increase in pressures on marine installations with resultant higher efficiency. For this purpose, marine turbines have been developed both for geared and electric drives.

The towboat Indiana used on the Mississippi and Ohio Rivers is driven by Westinghouse electric propulsion

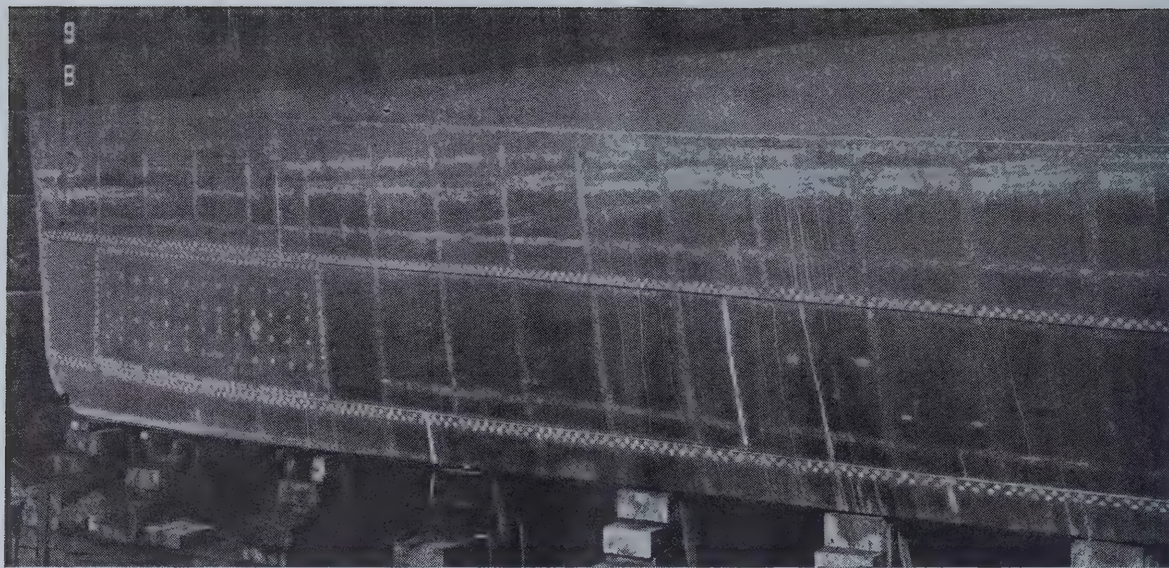


Fig. 1.—Port bow of U. S. S. Monaghan showing how deposit occurs only on rivet points, butt welds and spots located over areas of interior welding

Investigation of

DEPOSIT ON RIVET POINTS

By Lieut. (jg) M. G. Vangeli, (CC), U. S. N.*

A peculiar white deposit on certain underwater areas of the U. S. S. *Monaghan* was observed during a recent docking incidental to the building of the ship. With the co-operation of Dr. J. F. G. Hicks of the Massachusetts Institute of Technology, and the Chemical Laboratory and Electrical Shop of the Boston Navy Yard, the author made an investigation of the nature and causes of the deposits with the following results:

History. The underwater hull of the U. S. S. *Monaghan* is built of weatherized galvanized steel plates joined with ungalvanized steel rivets and welding. The hull was red-leaded two months before launching and on January 9, 1935, the ship was launched without any application of anti-corrosive and anti-fouling paint.

At the pier, the ship was connected to yard direct-current power and grounded for welding with grids, as shown in Fig. 3. About two months later the ship was hauled up on the marine railway and it was observed that a white deposit covered each rivet point, each bead of exterior welding, and certain spots on the underwater hull where interior welding might have burned off the galvanizing. Figs. 1, 2, 5 and 6 show general and detailed views of the incrustation on the port bow of the *Monaghan*.

When the incrustation was scraped off the underlying red lead came off with it leaving the bare metal of the rivet points exposed, but still covered with the black oxide film formed when driven. The red lead was in the process of disintegration over areas of the hull in the vicinity of the deposits.

Experimental Work. The yard chemical laboratory analyzed the deposit and found it to be mostly magnesium and calcium carbonates.

The laboratory set-up shown in Fig. 4 indicated that the carbonates did not come from the structural materials of the ship. A formation of the identical deposit found on the ship and almost $\frac{1}{16}$ inch thick was obtained on the cathode of Fig. 4 in two days.

The tests shown in Figs. 7 to 10, inclusive, indicate that harbor stray currents exist of such intensity and direction as to give cathodic electrolytic action at the ship's hull when the ship is grounded, similar to the action that took place with the two carbon rods.

Measurements of resistance through rivet points, burned areas, and galvanized areas of model sections of the hull plating, Fig. 11, indicate that the resistance through the galvanizing is at least eight times that through the other two paths. This results in a concentration of current at the rivet points and burned areas with resultant electrolytic concentration at these points.

The difference in resistance of circuits through galvanizing and those free of galvanizing is accounted for by the fact that when galvanized plates are exposed to weather in the storage racks a film of zinc carbonate forms on galvanizing. This carbonate has a very high resistance, and the film acts as an insulating medium to give the great difference in resistance.

Two tests of red-leaded model sections of the underwater plating, first taking power from the positive and then from the negative side of the line and connected, as shown in Fig. 12, to duplicate pier conditions, indicate that the gases formed by electrolytic action first blister the red lead and then gradually break it off me-

* The opinions or assertions contained herein are the private ones of the writer and are not to be construed as official or reflecting the views of the Navy Department or the Naval Service at large.

chanically. Magnesium and calcium carbonates were again deposited on the cathode.

Theory. Figs 7, 8, 9 and 10 show that the ship was the cathode in a harbor stray current circuit. The elements found in sea water exist largely in the ionized state. This being the case, the following actions can take place, among others, to give insoluble magnesium and calcium carbonates that will precipitate on the cathode:

$$
\begin{array}{lrclcl}
(1) & H_2O & + & \text{Electricity} & = & H + OH \\
(2) & OH & + & HCO_3 & = & H_2O + CO_3 \\
(3) & Mg & + & CO_3 & = & MgCO_3 \\
 & Ca & + & CO_3 & = & CaCO_3
\end{array}
$$

Theory and the tests show that chlorine is liberated at the anode, some of which reacts with water to form hydrochloric and hypochlorous acids, thus:

$$(4) \quad Cl_2 + H_2O = HCL + HClO$$

Both of these acids will attack unprotected steel.

Discussion. The incrustation under discussion was observed only on the *Monaghan,* although her sister ship, the *MacDonough,* was tied up in the same waters at the same pier. But the *MacDonough* was not grounded to the yard neutral, so that the stray voltage acting on the *MacDonough* was only 5 volts as compared with 10 volts on the grounded *Monaghan.* A certain minimum voltage is required to start electrolytic action, which, under the conditions obtaining at the pier, is believed to be about 6 volts. Hence no action took place in the case of the ungrounded *MacDonough.*

In the case of the *Monaghan,* the action must have taken place over the entire surface of the underwater hull. But the current concentration over the galvanized portions was so low that the crystallization of the carbonates on the plating probably took place slowly enough to allow the deposit to drop off as fast as formed, or to be dissolved in the sea water.

Analysis of the scum formed in the test shown in Fig. 12, when the model was the anode, showed a trace of iron; probably resulting from action between the plate and HCl and HClO after the paint was broken off. But visual examination of the *Monaghan's* hull showed no apparent corrosion of the rivets, welding beads, or galvanizing.

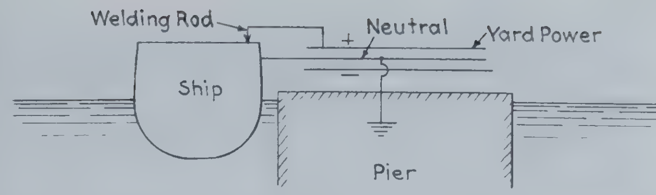


Fig. 3.—Electrical hook-up to yard power for welding on ship at pier

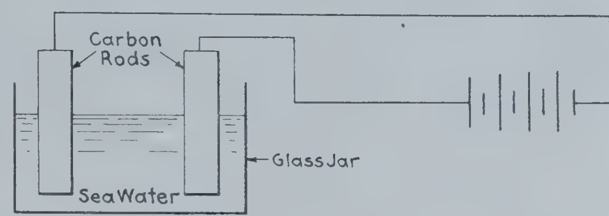


Fig. 4.—Laboratory set-up which gave deposit of magnesium and calcium carbonates on cathode

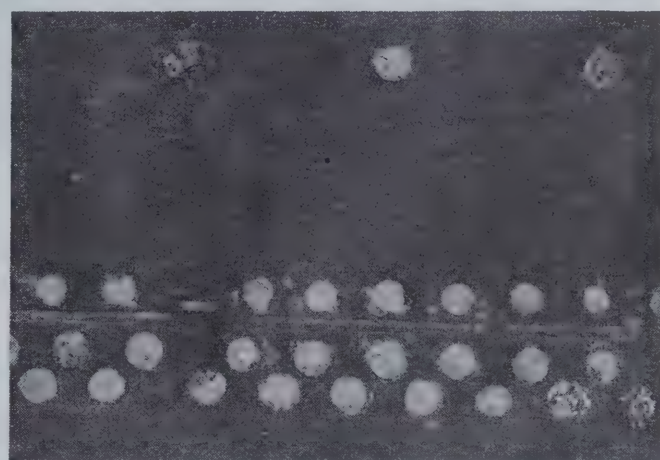
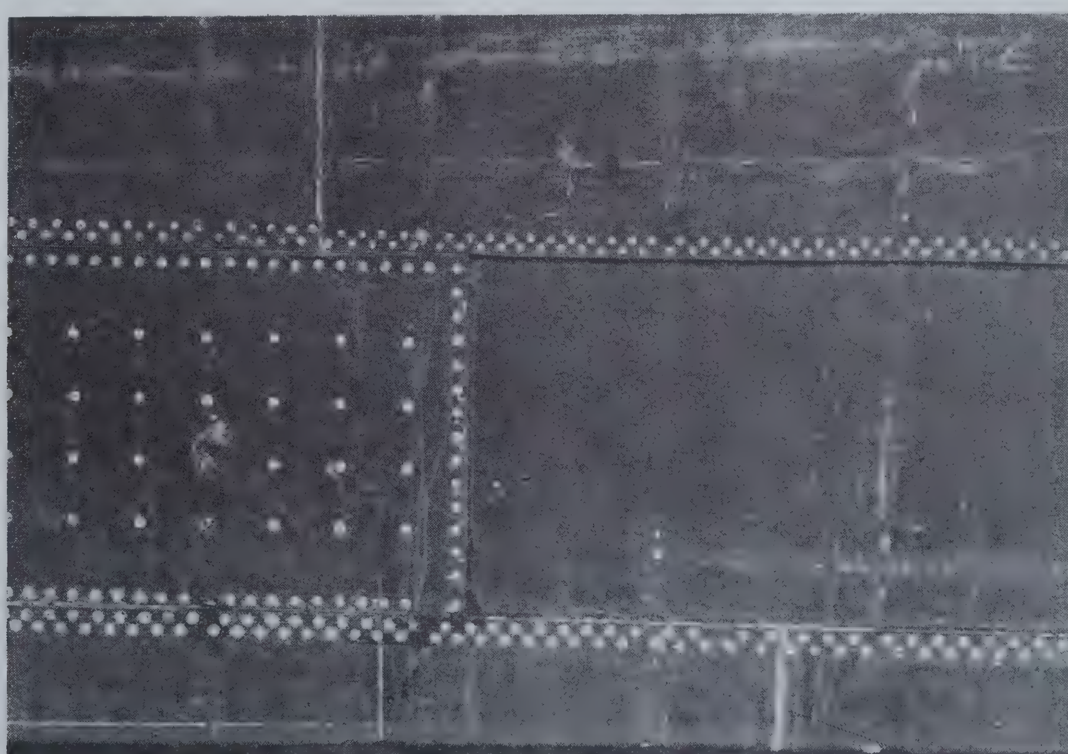


Fig. 5.—Close-up of incrusted spots. Note condition of red lead in vicinity of deposit

Fig. 2.—Close-up view of plating showing deposits on rivet points and the welded areas



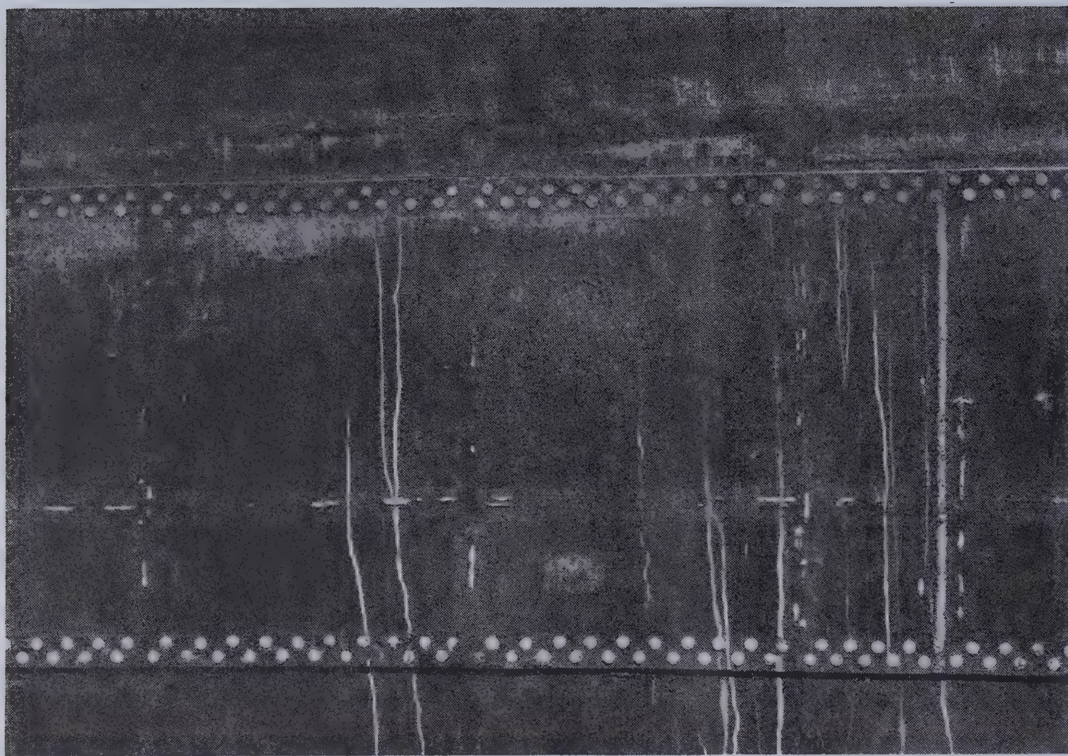


Fig. 6.—View showing how red lead coat has begun to disintegrate in vicinity of deposits. White streaks are dried seawater salt. Note deposit on the welded butt at the right

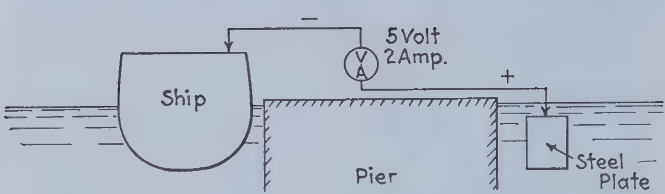


Fig. 7

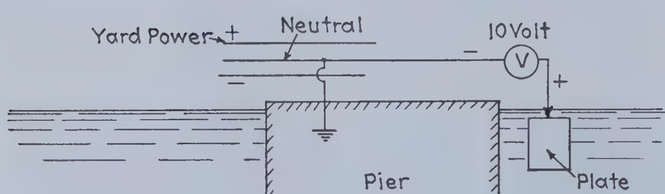


Fig. 8

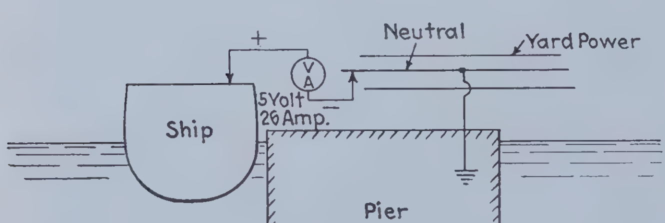


Fig. 9

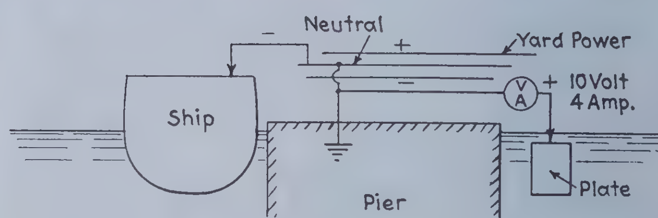


Fig. 10

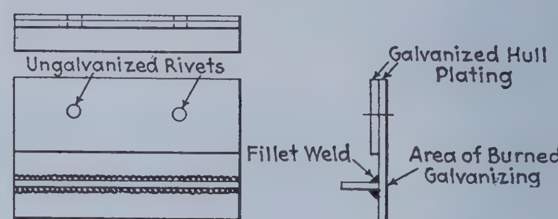


Fig. 11.—Model section of hull plating thoroughly red-leaded, used for resistance and electrolysis tests

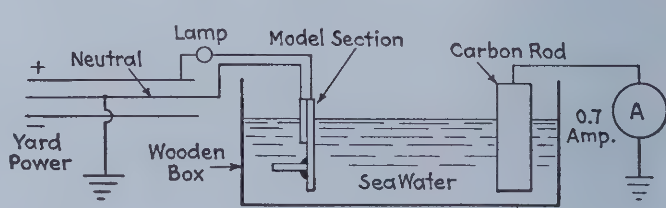


Fig. 12.—Laboratory set-up that gave carbonate deposit on cathode and disintegrated red lead

In the final analysis, the electrolytic action merely resulted in the precipitation of marble out of the sea water and on to the points of greatest current concentration at the cathode.

Conclusions. (a) The elements composing the incrustation came out of the sea and not from the structural material.

(b) No great danger from corrosion exists as a result of these phenomena other than the ordinary danger to be expected after the paint film is broken down.

(c) It is believed that this action can be prevented, if the ship is not grounded to the earth.

Result. The underwater hull was cleaned and painted. The ground wire to the ship at the pier was not replaced when the vessel was undocked. In addition, many of the welding grids were replaced with welding machines. Some two months later, the *Monaghan* was docked again. No sign of further deposit was observed.

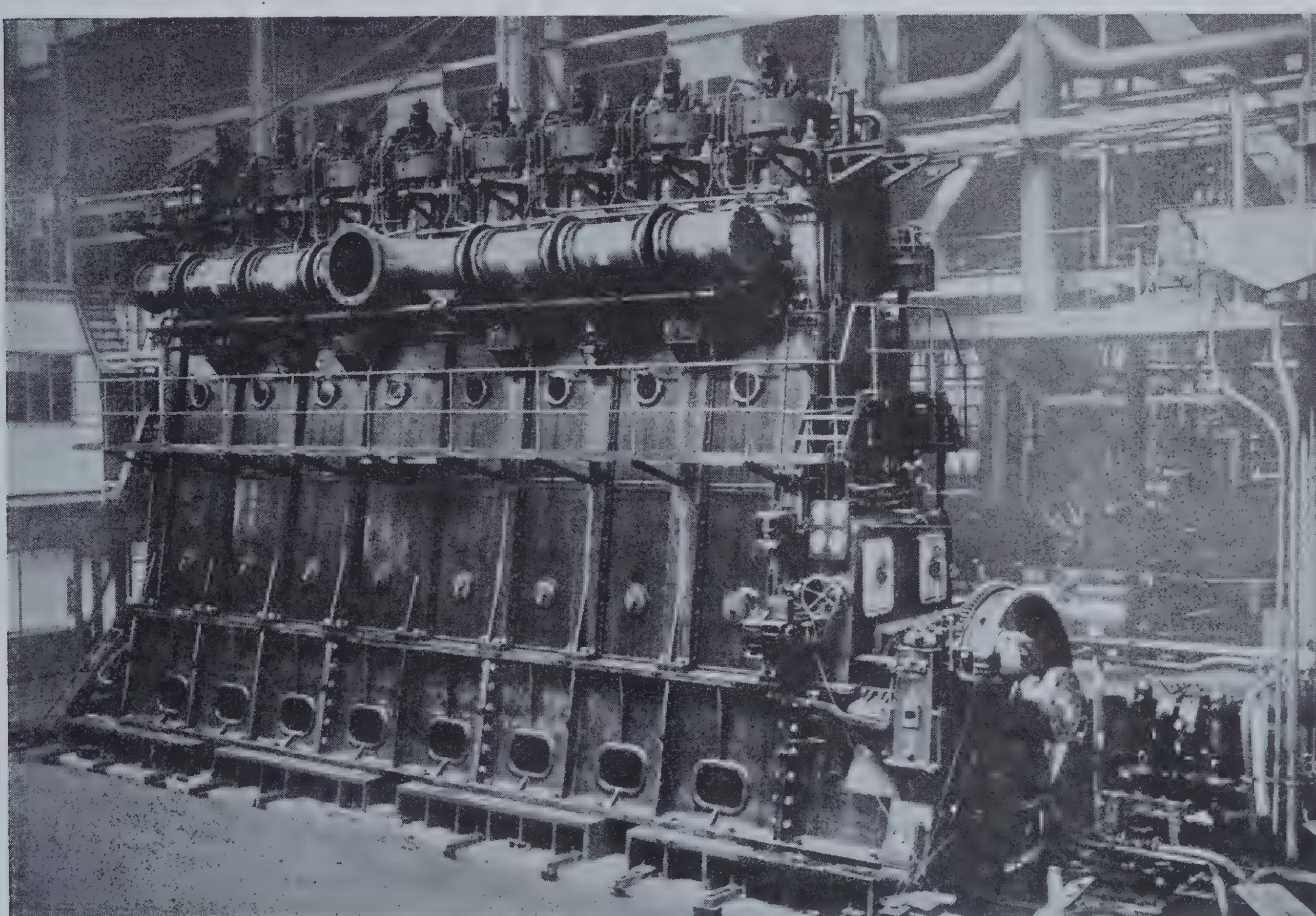
New Diesel Engine Designs

By Our London Correspondent

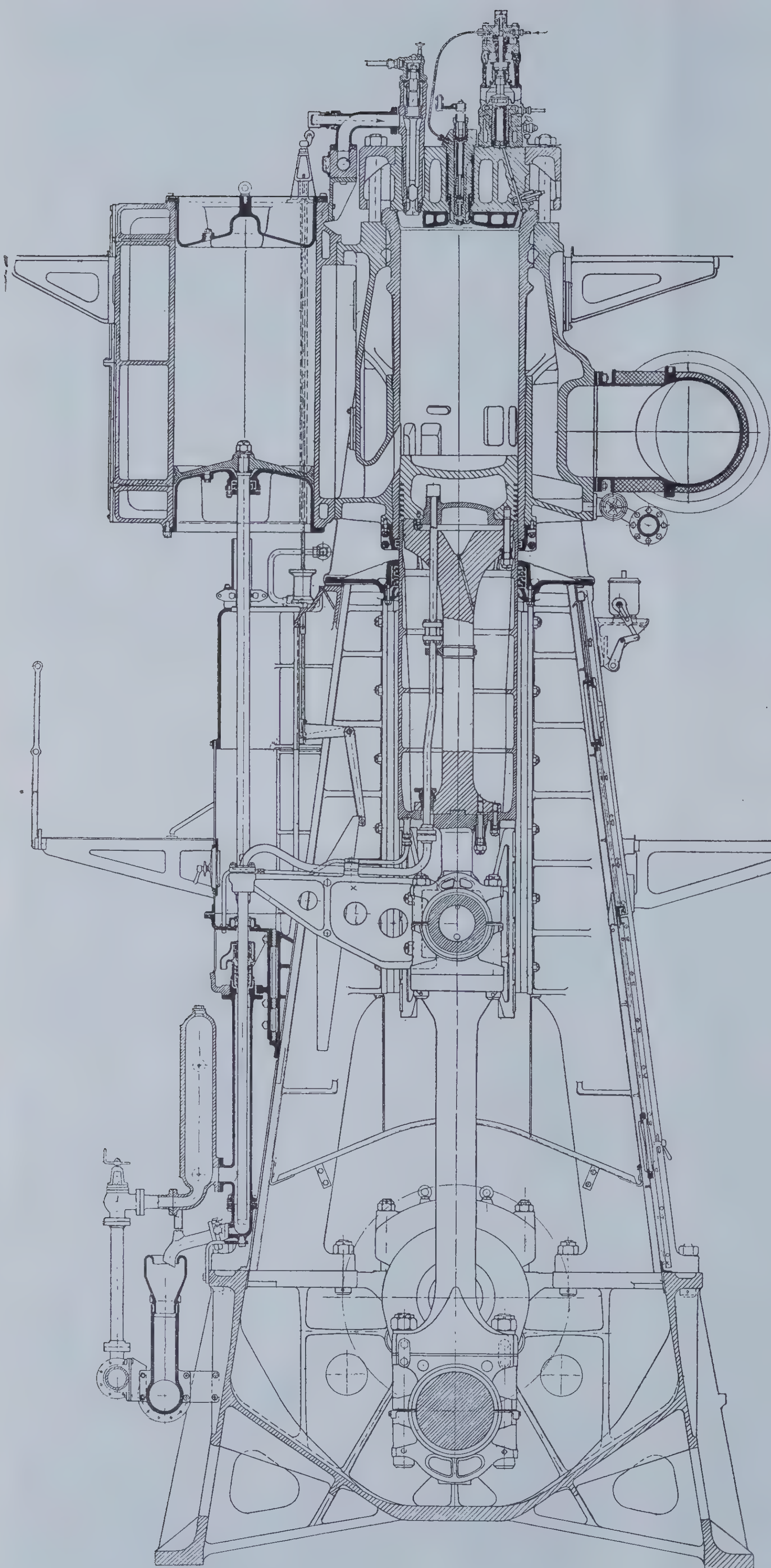
In the latest Krupp two-stroke single-acting engine the high-pressure fuel pump is eliminated and the fuel is injected into the working cylinder through the medium of the compression pressure within the cylinder itself. In the new Richardsons, Westgarth double-acting two-stroke engine the cylinder columns and bedplate are of welded steel plate construction, substantially reducing the weight of the engine

Although with the demand for new tonnage which is developing in Europe, marine engine manufacturers are not desirous of embarking on new designs, there is a surprising activity in the engine shops with the object of producing more simple, cheaper or more efficient marine Diesel machinery. There are even one or two entirely new Diesel engines being manufactured, including the Richardsons, Westgarth, which is the first double-acting two-stroke unit of purely British design and of which type a 4400-brake-horsepower model is about to be installed in a single-screw cargo ship.

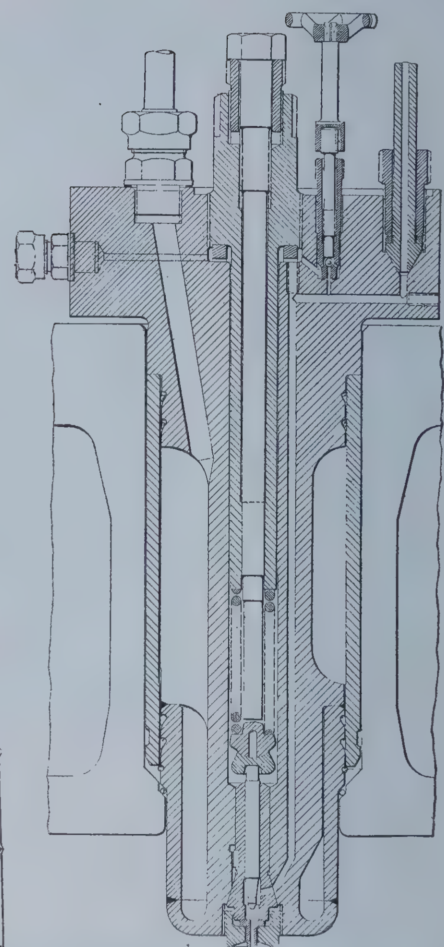
In most cases, however, modifications, minor or important, are being made to existing types. The most notable recent development of this nature is seen in the latest Krupp two-stroke single-acting engine with which favorable results are stated to have been obtained. The chief feature lies in a modification of the fuel-injection system which has frequently been attempted by designers but has never previously been satisfactorily obtained. It aims at eliminating the normal high-pressure fuel pump and injecting the fuel into the working cylinder through the medium of the compression pressure within the cylinder itself. It is obvious that such a method results in a considerable simplification of mechanism, since the individual high-pressure fuel pumps with their operating mechanisms are rendered unnecessary and reversing is naturally simplified as the time of injection of fuel, being dependent on compression pressure, automatically follows the piston and is similar for ahead or astern running.



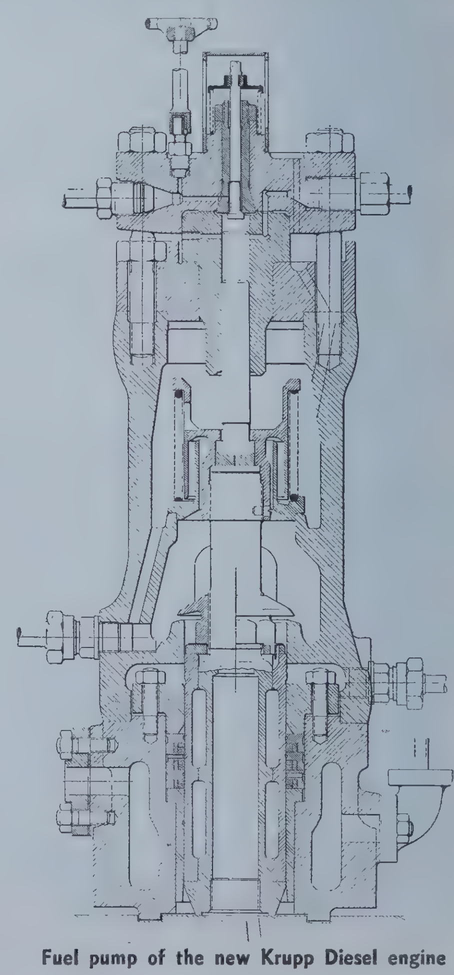
New Krupp two-stroke single-acting Diesel engine of 3600 brake horsepower



Sectional end elevation of Krupp two-stroke single-acting Diesel engine, developing a maximum of 3600 shaft horsepower, equipped with the Archaouloff system of fuel injection



Section through water-cooled fuel injection valve



Fuel pump of the new Krupp Diesel engine

The compression pressure in the cylinder is, of course, insufficient for satisfactory injection and atomization of fuel. The method employed is to fit on the cylinder cover a small cylinder with differential pistons, the smaller diameter piston forming a plunger working in a cylinder which delivers the oil to the fuel valve at a pressure of some thousands of pounds per square inch. The compressed air from the combustion cylinder is delivered to the under side of the larger diameter plunger of the differential piston. The compressed air operated fuel pump, as it may be termed, is little larger than an ordinary valve, and, as the fuel injection valve is of normal design and size, the whole fuel mechanism is extremely simple and compact. The engine is, itself, thereby simplified, since the scavenging air is admitted through ports and the exhaust gases discharge through ports on the opposite periphery at the bottom of the cylinder. The whole control for the reversing is connected to an air distributor, which is a small unit arranged close to the control station.

The design thus outlined appears very simple, but certain practical difficulties were experienced during the early period of its development, and it was only after a prolonged series of trials in the shops and at sea that a completely efficient and reliable mechanism was evolved. The arrangement has already been adopted in some marine Diesel engines of the air-injection type which were converted to airless injection by the employment of the arrangement described.

So far as the efficiency is concerned, the results have been good. The engine has eight cylinders with a diameter of 650 millimeters and a piston stroke of 1250 millimeters and at 110 revolutions per minute the output is 3600 brake horsepower. The minimum fuel consumption, at 2500 brake horsepower or 3050 indicated horsepower, was found to be 133 grams per indicated horsepower hour, which is equivalent to 160 grams per brake horsepower hour (the mechanical efficiency being 82 percent). This represents a consumption of under 0.36 pound per brake horsepower hour, which is equal to that of almost any other type of marine Diesel engine of this size. At full power, the consumption is about 4 percent higher, a characteristic of most Diesel machinery being that maximum efficiency is obtained at approximately 70 percent of full output.

The engine in other respects has certain peculiarities. With the object of rendering it self-contained, there is a scavenging pump for each pair of cylinders, actuated by the engine itself. The combustion cylinder blocks are carried on cast-iron columns and each block forms two cylinders into which the liners are fitted. For each pair of cylinders thus built, there is a scavenging pump bolted to the cylinder block at the same level the plunger being driven from one of the engine crossheads, by a rigid cantilever which also carries the telescopic pipes fitted into corresponding tubes for the supply of cooling water to the pistons.

A great deal of experimental work on the subject of scavenging was carried out before this type of engine was developed. As already recorded, the exhaust ports occupy a part of the periphery of the cylinder at the bottom and the scavenging ports are opposite, being somewhat lower than the exhaust ports. In addition, however, to the main scavenging ports, there are also small openings above them, in communication with the exhaust pipe. The object of these is to prevent the formation of eddies in the scavenging air stream as it passes upwards, a complication which, it is stated, has proved to be warranted in the satisfactory running of the engine and the efficiency obtained.

Sea water is employed for cooling and in view of this it is essential to have the telescopic pipes supplying the cooling water to the pistons external to the crank case. The outgoing water is delivered into open tun-dishes. The cylinder head is of two-part construction, the lower portion in contact with the gases at maximum temperature being of cast steel. There is a direct communication in the cylinder head between the combustion chamber and the under side of the fuel pump, so that the air on the compression stroke is delivered direct to the differential piston as already described.

The first two engines built have now been in operation at sea for two or three months and it is stated that their performance has been up to expectations and no difficulties have been experienced in the running of the machinery.

A Double-Acting Two-Stroke Engine. The Richardsons, Westgarth two-stroke engine to which reference was made above, being a new type, comes into quite a different category. It is a double-acting two-stroke design and by the adoption of electric welding the builders claim that it will represent the lightest slow-running marine Diesel engine on the market. This is the first time that electric welding has been employed in the construction of a big mercantile Diesel engine, except for the Doxford opposed piston type. With the latter, however, the problem is different, since the framework does not take the combustion stresses, as it does in the ordinary single-piston engine.

The first engine just completed has four cylinders 27½ inches in diameter, with a piston stroke of 47½ inches. The maximum power is 4400 brake horsepower, the normal output in the ship being 4000 brake horsepower at 109 revolutions per minute. The overall length is 22 feet 6 inches and the width 14 feet. The cylinder columns and the bedplate are of welded steel plate construction. In order that the tensile stresses should not pass through the welded section, steel tie rods pass from the bottom of the bedplate to the top of the cylinder framework. The bedplate is built up with the sump, the bottom being in two lengths. It is stated that in the construction of the bedplate, with electrically welded steel plates, a saving of 15 tons has been effected, the total weight being under 30 tons.

Apart from the system of building up the structure, the engine does not present many novel features. It is a matter of interest, however, that it was originally intended to drive the cam shaft by chain, but this was found to be unsuitable and the arrangement was altered to a gear and vertical shaft drive. It is worth noting, as bearing on the recent development of Diesel machinery, that the first of the new engines is to be fitted in the same engine room as a unit of about half the power, which it is to replace. This was built less than ten years ago.

Submarines Use Electromode Heat

One of the out-of-the-ordinary uses for Electromode electric unit heaters is their adoption for heating submarines. The Electric Air Heater Company Division of the American Foundry Equipment Company, Mishawaka, Ind., has just received an order for thirty-three of its 4-kilowatt heaters for use in submarines being built by the Electric Boat Company. During the past few years, practically every submarine built has been heated with this marine type heater.

Electromode heaters are also being used for complete heating of buildings, the heating of isolated rooms, and of offices. Made in three styles beside the marine type, the Electromode is available in a portable unit, an industrial type unit, and the built-in-wall type.

Methods developed for

CONTROLLING SUPERHEAT*

By Thomas B. Stillman†

The fundamental reason for controlling superheat is to provide steam temperatures at the turbines which are most suitable for their efficient operation over a relatively wide range of rating of the boilers. Another reason of almost equal importance in modern high temperature installations on shipboard is to insure proper steam temperatures under maneuvering conditions, so that possible damage to the propelling machinery and condensers will not occur. Also, in a marine installation, the steam requirements in port are radically different from those under way, requiring control of the superheat to meet these special conditions properly.

Aside from the effect change of boiler rating has upon superheat, there are a number of other factors in connection with boiler and furnace operation that affect superheat.

Increasing the feed-water temperature to a boiler decreases the superheat for a given rating. This is because an increase in feed-water temperature increases the steam flow through a superheater, with no corresponding change in the gas flow over the superheater.

A number of the auxiliaries as well as the heating load usually require saturated steam. If this steam is taken directly from the boiler drum, the steam so taken by-passes the superheater, and the remaining steam absorbs more heat per pound than if all the steam generated by the boiler went through the superheater.

It is because of this radical effect that by-passing of steam has upon the temperature of the remaining steam coming from the superheater under maneuvering conditions that desuperheaters for auxiliary steam have come into quite general use aboard modern steamships. In this way, all of the steam generated by the boiler is allowed to pass through the superheater at all times, the auxiliary steam then being desuperheated as required.

The percentage of boiler surface between the superheater and furnace is an important factor in the slope of a superheat-rating curve. A convection-type superheater well removed from the furnace will show a rapid percentage increase in superheat with rating. As the superheater is moved nearer the furnace the superheat-rating curve tends to flatten, and it is possible to locate a superheater so that it will have a flat superheat curve over a wide range of rating. A radiant-type superheater located in the furnace walls will give decreasing superheat with increase in rating. By combining a radiant-type superheater with a convection-type in the same boiler, a comparatively flat superheat curve may be obtained.

With our present knowledge of metals, the commercially feasible procedure aboard ship is to have the superheater so located in the boiler that a rising superheat with rating characteristic will be obtained.

From the preceding it will be realized that, as higher steam temperatures are employed and less margin is left for the designer to work to, some form of superheat control becomes essential, not only to assure a relatively flat superheat-rating curve, but also to take care of the possible variations in superheat that may occur due to the operator's procedure in handling the boilers.

Fundamentally, there are two principles generally employed for controlling superheat: (1) Providing an excess of superheating surface so as to give the desired steam temperature at low rates, with provision for cooling the steam at the higher rates, and (2) controlling the flow of gases over the superheater so that the steam temperature always remains within certain limits regardless of the rating of the boiler.

The cooling type of control may be divided into (a) those injecting water into the steam and (b) those cooling the steam in a heat exchanger by conducting the excess heat to the feed water or the boiler circuit: (a) may again be divided into (1) spray-type desuperheaters and (2) those employing surface evaporation, where water is allowed to trickle over wires or metal surfaces exposed to the superheated steam, the water being evaporated and picked up by the steam as it flows past.

The spray-type desuperheaters are relatively simple and compact, but to obtain consistently satisfactory results with them the water should be finely atomized and a reasonable length of travel allowed the steam beyond the spray before its utilization in a turbine to insure complete evaporation of the water and thorough mixing of the steam. Suitable automatic thermal control should be provided to govern the amount of spray water, the thermal element being located some distance down the pipe to assure properly mixed steam for actuating the control.

With spray-type desuperheaters it is also essential that the spray water used be of exceptional purity, if difficulty

* Abstract of paper presented at forty-third annual meeting of The Society of Naval Architects and Marine Engineers, New York, November 15.

† Engineering department, The Babcock & Wilcox Company, New York.

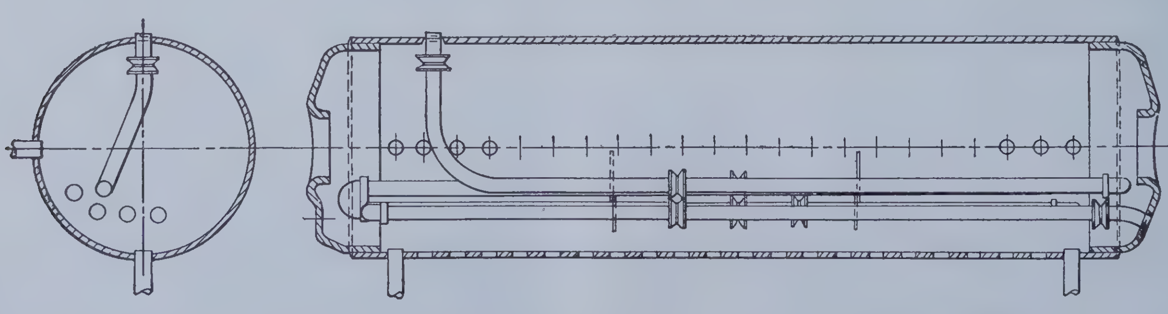


Fig. 1.—Coil type of convection desuperheater located in boiler steam drum for supplying auxiliary steam

is to be avoided further along in the circuit with impurities in the steam.

The surface evaporation type of desuperheater largely eliminates the carry-over of solids from the water to the steam, the majority of these being left on the wires, but the control picture, from the point of view of momentary water carry-over or excessive steam temperature under conditions of varying steam flow, is similar in both types.

The convection type of desuperheater eliminates the possibility of contamination of the steam with impurities from the cooling water, as the two are never allowed to mix. As previously indicated, either feed water or water from the boiler may be used for the cooling medium. Feed water permits the use of a smaller unit due to the better thermal head available, but the boiler water installation is the simpler from an operating point of view and will not cause fluctuations in the feed-water temperature as it enters the boiler.

Fig. 2 illustrates the construction and principle of operation of one of these units. The thermally actuated butterfly valve in the steam line serves to control the percentage of steam diverted to flow through the cooling tubes, which are surrounded with water. By varying the percentage of steam so diverted, any desired range in superheat may be obtained, and at no time will there be danger of water in the steam, if the cooling water is taken from the boiler circuit.

For providing auxiliary steam, the almost universal practice afloat today, in the higher temperature installations, is to desuperheat a portion of the steam which has been through the superheaters. This may be done with either the convection or injection type of desuperheater. However, it is to be kept in mind that, if proper control of the gas flow over the superheater is provided in the boiler unit, such desuperheaters will be unnecessary and saturated steam for auxiliary purposes may be taken directly from the boiler drum without introducing any hazard to the superheater because of this steam by-passing the superheater under maneuvering conditions.

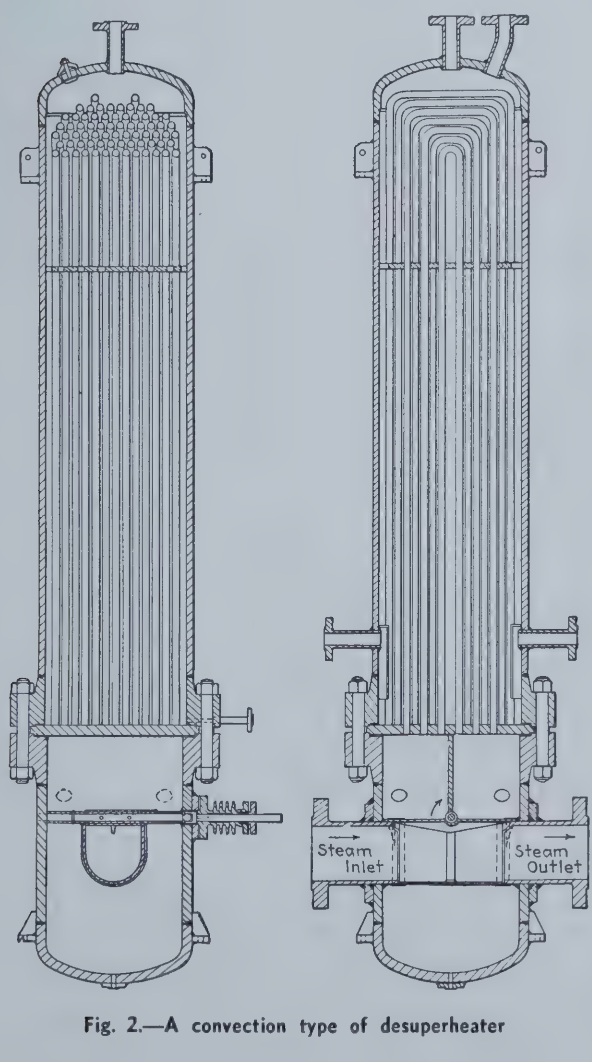


Fig. 2.—A convection type of desuperheater

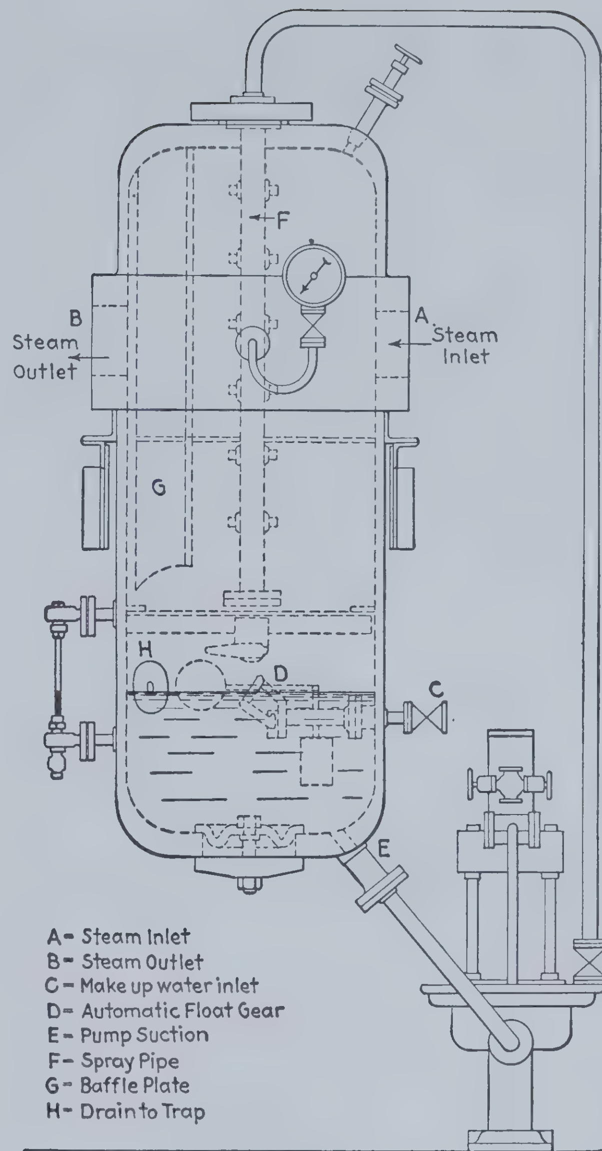


Fig. 3.—Spray-type desuperheater for supplying auxiliary steam

If auxiliary desuperheaters are necessary, unquestionably the simplest and lightest weight type is a coil of pipe located below the water level in the steam drum. This lessens accessibility in the drum, and also leaves the steam with some superheat in it (from 25 to 50 degrees F.), but there are no moving parts and nothing requiring periodic attention. Fig. 1 shows a desuperheater of this type, designed to handle up to 10,000 pounds of steam per hour from 252 degrees F. superheat to 30 degrees F. superheat, located in the steam drum of a header-type boiler.

The spray and surface evaporation types of desuperheaters are more liable to fluctuations in superheat, especially if the primary steam temperature is relatively high; but, on the average, an auxiliary load is fairly steady, which is an important factor in the successful

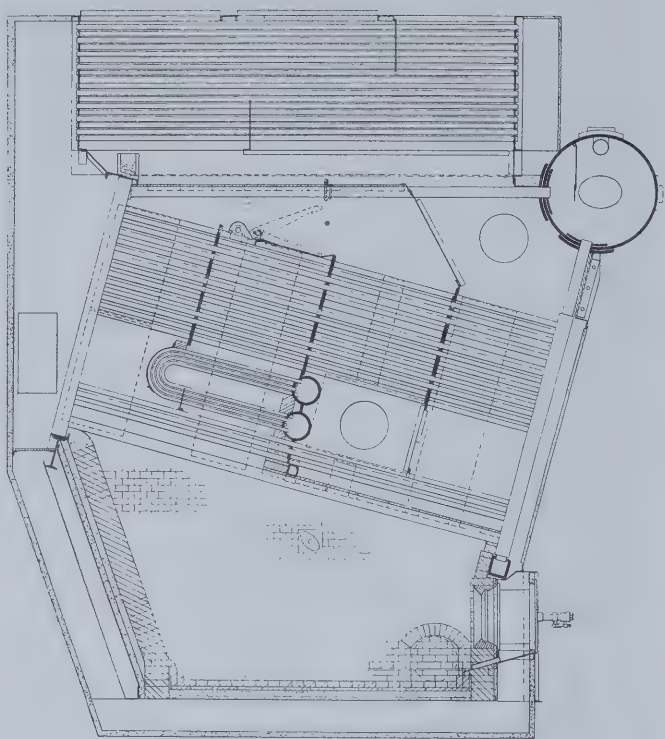


Fig. 4.—Header-type marine boiler fitted with damper for controlling superheat

performance of such an installation. Fig. 3 shows a spray-type desuperheater which has found wide application in European marine installations for providing saturated steam to the auxiliaries.

Control of superheat by regulating the flow of gases over the superheater is accomplished in two general ways: (1) By means of dampers, and (2) with separately fired superheaters.

When dampers are used for controlling superheat, they may be located somewhere in the boiler, but usually, for marine service, it has been customary to place them in the uptake. If a damper is located in a boiler, it should be placed far enough from the furnace to prevent the possibility of its overheating and warping at the designed maximum rates of operation. The use of heat-resisting alloys for this purpose will be a good investment in some cases. Also, if the quantity of gas to be controlled is relatively large, it will usually be desirable to install a number of small damper units rather than one large damper. This will appreciably reduce the warping hazard.

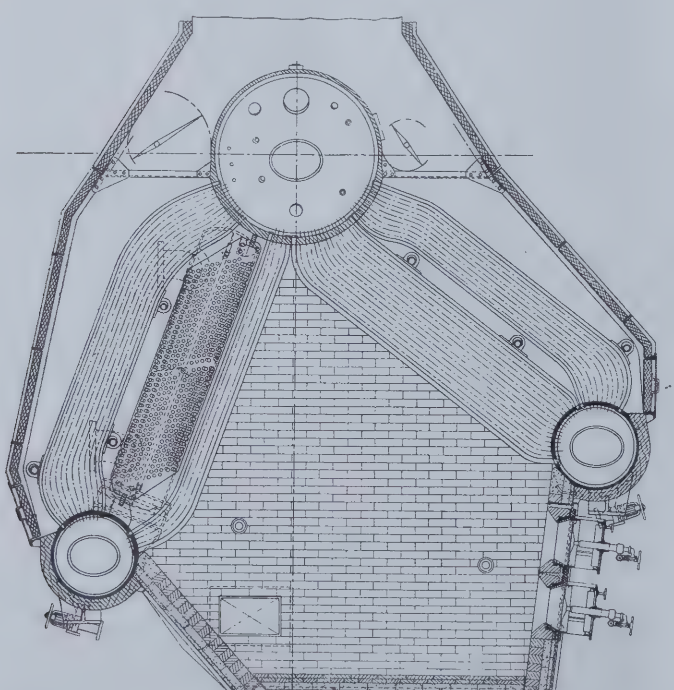


Fig. 5.—U. S. S. Farragut type of boiler at naval boiler laboratory fitted with dampers for controlling superheat

Regardless of where they are located, the use of dampers inherently introduces a condition of unbalanced gas distribution through the boiler unit, and in designing units so fitted care should be exercised to avoid the possibility of any damage occurring due to local concentration of hot gases on any portion of the heating surfaces, regardless of damper opening or rating of the boiler.

When raising steam in modern high-temperature boilers, care must always be used to avoid overheating the superheater unit. Restricting the flow of gases over the superheater at this time by means of a damper will reduce the possibility of such overheating and will also make it possible to place the boiler on the line faster than would be the case if the damper were not used.

Controlling Superheat by Gas Flow

In controlling superheat by means of gas flow, it is of course essential that the superheating surface be localized so that the desired control will be obtained.

Fig. 4 shows the application of damper control of superheat to a well-known header type of marine boiler. In this case the second and third passes of the boiler are swept by all of the gases regardless of the damper opening, assuring a relatively flat efficiency curve under all conditions of operation.

Fig. 5 shows one of the larger boilers installed in the U.S.S. *Farragut* type of destroyer. In the installations aboard the ships 49 percent closure dampers were placed in the uptakes above the saturated banks of the boilers only, but in the test boiler of this type at the Naval Boiler Laboratory in the Philadelphia Navy Yard dampers were installed in both uptakes in accordance with the arrangement shown in Fig. 5. The damper located above the saturated bank permitted a total closing of only 49 percent of the uptake area, to eliminate the possibility of damage to the superheater due to excessive restriction of the uptake on this side, whereas the damper above the superheater, when closed, stopped all flow of gas through that side of the boiler.

Unquestionably the ideal way of controlling superheat is by means of separately fired superheaters. It may not always be the most feasible way from a commercial, space, or weight point of view, but as a means of controlling superheat no other method has ever equaled it.

The simplest type of separately fired superheater is one made only of tubes containing the steam to be superheated, the furnace being made large enough so that there will be no danger of local flame impingement with consequent hazard of losing tubes due to such impingement.

When maneuvering a ship with such a unit, the fuel input may be reduced to give any desired superheat, the saturated boilers taking care of the power requirements. When coming in or out of port, the separately fired superheaters may be secured, the steam from the saturated boilers being ideal to meet these requirements. While the ship is in port, only saturated boilers need be on the line.

The primary disadvantage of the separately fired superheater for marine use is the fact that relatively

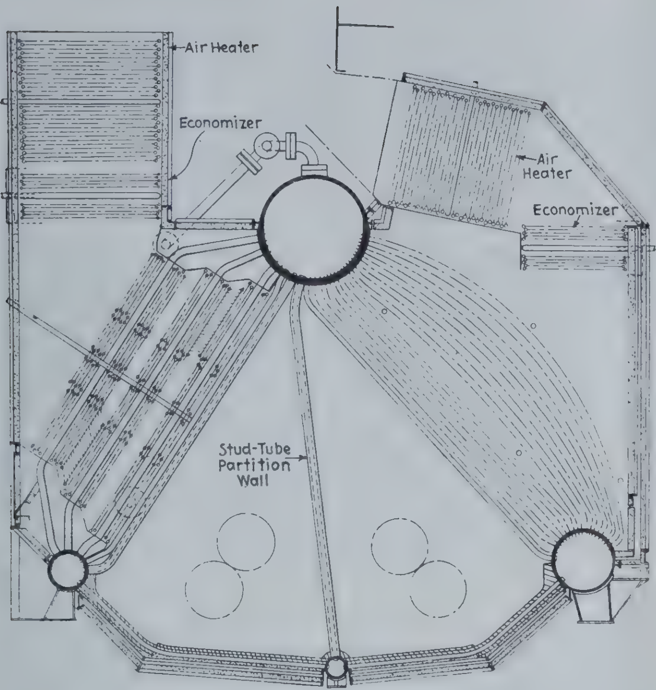


Fig. 6.—Integral separately fired superheater designed to generate steam at 1200 pounds per square inch pressure and 950 degrees F. temperature

large powers with a multiplicity of boiler units are desirable for its satisfactory application. To meet this situation the integral separately fired superheater was developed to provide all the advantages of separately fired superheaters, without increasing the number of units in the boiler room of a ship of moderate horsepower.

Fig. 6 shows a unit of this type which has been developed to supply steam at 1200 pounds pressure and 950 degrees total temperatnre when under way. A further requirement in this particular installation was that 100 percent of full ahead steam be provided for maneuvering purposes at a temperature not to exceed 750 degrees F.

Automatic Combustion Control

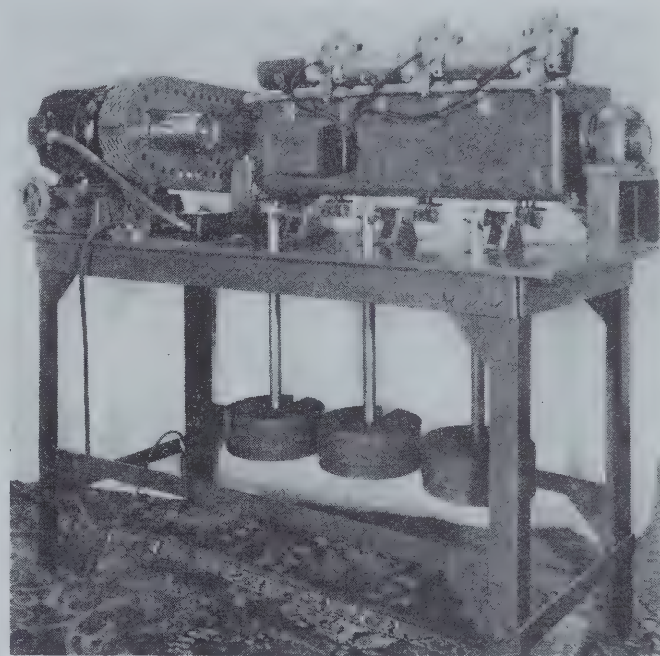
For the unit shown in Fig 6, automatic combustion control is provided which assures any desired steam pressure and temperature over the entire range of boiler rating. Wide range oil burners having no return flow of oil are used. The burners and their air supply on the saturated side of the boiler are controlled by the steam pressure in the boiler drum, the burners and the air supply to them under the superheater side of the boiler being controlled by the temperature of the steam at the superheater outlet.

The gas-tight water-cooled wall separating the saturated and superheater sides of the furnace is of the Babcock & Wilcox Company stud-tube design having refractory surfaces exposed to the furnace which assist in maintaining the combustion efficiency in the small furnaces available in marine work and also reduce the heat absorption per square foot of wall, so that there is little danger of local overheating of the wall tubes even in the burner zone.

Control of superheat is an accepted necessity in the modern steamship. Applying the most feasible control from a practical operating and efficiency point of view is the problem facing the naval architect and owner. There are a number of ways of doing it, and each installation must be carefully analyzed to insure that the procedure followed is the best for the particular service under consideration.

Machine for Testing Cutless Bearings

Included in the exhibit by Lucian Q. Moffitt, Inc., Akron, O., national distributors of Goodrich cutless bearings, at the 1936 Motorboat Show will be a unique testing machine showing several types of bearings in actual operation under typical service conditions. By means of the device it is possible to observe the actual effects of sand and grit on bearings and shafts.



Machine to show wear resistance of bearings

The machine consists of a tank filled with sandy water in which a shaft is operated by an electric motor. The shaft is carried in three different type bearings, one of which is a rubber cutless bearing. A section of each bearing is cut away so that the condition of both shaft and bearing may easily be seen. The sand is prevented from settling by means of several motor driven agitators placed along sides of the tank. The purpose of this demonstration is to show how the rubber surface of the cutless bearing prevents scoring of the shaft by sand.

This exhibit will also include a full size model of the stern of a boat to illustrate method of bearing installation. In addition there will be a complete display of various sizes and types of cutless bearings.

Shim Stock Dispensing Unit

A new Shim stock dispensing unit has been announced by the Laminated Shim Company, to save time and space in stock rooms, tool rooms, and maintenance departments. It also saves cutting-space on work benches.

It keeps all sizes of stock together in one place; and by hanging it in the location most convenient for everyone it will save additional time in trips to and from the work. It holds all thin shim stock and 2-inch by 9-inch Laminum strips in a small wall space.

The unit is available without charge, being supplied with a special assortment of shim stock. Write the manufacturers, Laminated Shim Company, Inc., 21-24 44th Avenue, Long Island City, N. Y.

Annual Meeting of The Society of

NAVAL ARCHITECTS

The second day's proceedings of the forty-third annual meeting of The Society of Naval Architects and Marine Engineers, which was held in New York on November 14 and 15, 1935, comprised two technical sessions, one in the morning and the other in the afternoon. An abstract of the proceedings of the second day's sessions is given in the following:

The forty-third General Meeting of The Society of Naval Architects and Marine Engineers was held in New York on November 14 and 15, 1935. A brief report of the first day's sessions was published in the December issue. An abstract of the proceedings of the technical sessions on the second day of the meeting is given in this article

Methods Used in Producing Marine Gearing

By William E. Sykes

An abstract of this paper will be published in an early issue.

Discussion

W. W. Smith: A large diameter is advantageous for the gears of merchant ships. It is desirable to use welded construction for the gear case and foundation to secure rigidity. To avoid distortion, gear wheels should be stress-free structures, with the wheel a forging or welded structure in which the shaft is integral with the wheel. Harder materials would permit increased tooth pressures, thus reducing size and weight of the gear unit.

In two tankers which are now being built at the Federal yard, the main gears are of the Sykes type. Due to the absence of space between the helices, the integral arrangement, the higher revolutions, and the higher tooth pressures, the gears are very compact; the space and weight being considerably less than for previous gears. Table 1 gives a comparison between these gears and the ones installed on the *G. Harrison Smith* and *W. S. Farish*. For the values per shaft horsepower, the Sykes gears referred to the previous gears as unity are as follows:

Length	0.74
Floor area	0.59
Volume	0.53
Weight	0.62

Approximately, the space and weight of the Sykes gears are two-thirds of the previous ones, which is an important step in advance.

Table 1.—Comparison Between Sykes and Previous Gears

	A	B
1. General.		
Installation Ships	*G. H. Smith* / *W. S. Farish*	*R. T. Resor* / *T. C. McCobb*
Shaft horsepower	4,000	3,000
2. Revolutions.		
Propeller	75	90
Turbine, high pressure	5,480	6,000
Turbine, low pressure	4,270	4,400
3. Space and weight. Total.		
Length, feet	13.0	7.2
Floor area, square feet	195	87
Volume, cubic feet	2,340	930
Weight, pounds	160,000	74,300
4. Space and weight per shaft horsepower.		
Length, feet per 1000 shaft horsepower	3.25	2.4
Floor area, square feet per 1000 shaft horsepower	49	29
Volume, cubic feet per shaft horsepower	0.59	0.31
Weight, pounds per shaft horsepower	40	24.8

J. W. Atkinson: The hall-mark of approval of the hobbing process is given by the fact that practically all reduction gears for marine turbines, as well as for other prime movers, have been and are cut by this method, and this record embraces propulsion installations of all types and powers.

Regarding the running clearance of 0.003 inch per inch of circular pitch, Parsons' practice is to have an actual clearance normal to the teeth of not less than 0.020 inch, and even this would be increased depending on the pressure angle and other factors. The relation of journal clearance to tooth clearance should be taken into account. Ample tooth clearance is no detriment but rather an advantage to satisfactory operation and eliminates all possibility of trouble due to differential expansion in service between the gearing and its casing.

P. C. Day: Any sound method of gear generation can be developed and improved almost indefinitely. However, the type of machine which has the smallest number of fundamental sources of error would appear to be the logical subject for development, and the hobbing machine and principle are so evidently indicated that not far short of 100 percent of all the modern marine turbine gears in service all over the world have been produced on hobbing machines.

The modern hob is finished by precision grinding after hardening and, no matter whether it is of the multi-thread type, with relatively steep spiral angle, corresponding to the Sykes cutter with several individual cutting teeth, or the single-thread type which is used, exclusively, by the Falk Corporation and most, if not all, others for finishing marine turbine gears and pinions, it can be and is produced with equal accuracy of division and tooth contour to any other type.

It is misleading to suggest that the hobbing machine is a reciprocating machine. The fundamental advantage of hobbing as a principle with the greatest possibility of ultimate precision is that its cutting operation is performed, exclusively, by steady continuous rotary motion, holding all moving parts in the same relative positions regardless of necessary clearances. The fact that the hob slides must be returned between cuts implies no reciprocation during the cutting operation.

The greatest enemies to accuracy in its finer points are reversed clearances and unequal torsional displacements of rotating parts which must be accurately synchronized.

The writer would take mild exception to Mr. Sykes' limit of parallelism of 0.0003 inch per foot (of face width) for large marine turbine gears. It is question-

able whether such limits could be found by any convenient method of shop measurement.

The method of gear lapping described by Mr. Sykes has been used by us for many years and probably by others. Recent Falk developments include "burnishing" the teeth under heavy concentrated load and subjecting them to test loads, also concentrated, equal to several times the working load.

Our running clearance differs quite a little from Mr. Sykes' limits, averaging 0.015 to 0.02 inch—depending on diameter and possibilities of expansion. British practice averages nearly double these figures (0.03 inch). Large clearances tend to improve lubrication but clearances that are too small may lead to trouble.

The division accuracy of the Sykes method depends upon the combined precision of five elements—two pinion cutters, two index wheels for the cutters, and one main index wheel. To this is added the difficulty of controlling the inertia of two rather heavy masses which have to be reciprocated with considerable rapidity with both rectilinear and reversing torsional motion.

The hobbing machine with single-thread hobs has only one indexing element, the main dividing wheel, since a single-thread hob corresponds to a single-toothed pinion and can have no indexing error in reference to itself.

The hobbing machine has no problem of inertia to overcome; all its moving parts revolve or slide steadily in one direction from the start to the finish of the cut. That, in the writer's opinion, is the most important point for comparison.

Nobody who has followed the development of the Sykes machine could have anything but praise for the wonderful job that has been done; but the natural handicaps to ultimate refinement seem to be greater than is the case with the hobber.

A. Peterson: In 1892 Dr. De Laval designed and built a 15-horsepower geared turbine for a small vessel and in 1907 made up a design of a triple-expansion turbine with double helical gearing with two pinions, similar to present day installations. Lack of funds, however, prevented actual execution of Dr. De Laval's designs.

Over forty years ago, De Laval had produced helical gears operating satisfactorily at pitch speeds above 100 feet per second and the art of gear cutting was well known to De Laval engineers at that time. The De Laval Steam Turbine Company has been producing high-speed helical gears in this country since 1901 by means of the hobbing process. Some of these gears are still operating satisfactorily more than thirty years after installation. A properly designed and built hobbing machine employing accurate hobs with proper feed, etc., will produce a gear just as perfect as can be produced by any other known method.

Mr. Sykes is in error in stating that the tool in the hobbing machine reciprocates slowly. There is no such motion of the hob.

Mr. Sykes states that a central pinion bearing is seldom if ever necessary. This is not quite true. Practically all single-reduction marine gears are equipped with central pinion bearings and very often the second reduction of a double-reduction gear must be furnished with a central pinion bearing as otherwise the diameter of the gear would become excessive.

Mr. Sykes suggests that a backlash of 0.003 inch per inch circular pitch is sufficient. In view of the fact that the circular pitch of most high-speed gears is less than one inch, I do not agree that such a small backlash is sufficient, particularly if the gear is of large diameter. The backlash should be a function also of gear diameter and as a rule should not be less than 0.010 to 0.012 inch for the average marine gear.

J. A. Davies: While not wishing to detract from the credit which Mr. Sykes very properly gives to the late Sir Charles Parsons regarding the introduction of marine reduction gears, it is only fair to point out that the late Mr. George Westinghouse, in collaboration with Rear Admiral Melville, U.S.N., and Mr. John H. MacAlpine, did a substantial amount of pioneer work in this country during the period 1907 to 1909 in developing a high powered, and, what was considered at that time, a high speed reduction gear designed primarily for marine propulsion.

One need not be surprised that there will be differences of opinion with Mr. Sykes regarding his tendency to relegate the hobbing process to a position of marked inferiority when compared with the particular type of gear production which he represents. Mr. Sykes' comment that, "Many hobs in use are not as precise as they should be, because sufficient care and skill were not exercised in their manufacture," cannot in fairness be applied, at least to those companies in America who use the hobbing method for making gears for marine propulsion.

Regardless of the fact that "the machine is not seriously influenced by temperature changes," we are of the opinion that gear cutting under temperature control is a worthwhile procedure.

There is still plenty of room for investigation into the most desirable materials for pinions and gear wheels. The combination of a rolled steel rim with a cast center for the main gear wheel is, in the writer's opinion, a questionable one, as the residual stress in the gear rim, after it is shrunk on and pinned to the center, leaves much to be desired as a suitable base material in which to cut accurate gear teeth. An annealed cast steel wheel, or one of welded steel plate, in which the material at the rim is as free from stress as can be had with the present known technique for heat treating such materials, would seem to be a superior construction. On smaller gear wheels a forged structure might be used to advantage.

Ralph A. Miller: Mr. Sykes states that nickel-chromium steels, suitably heat treated, are satisfactory for pinions. In Volume 38 of the *Transactions* of this society, Mr. R. C. Waller stated that chrome nickel steel, heat treated to high physical properties, had not been found satisfactory for pinions, as the presence of chrome caused "ghost lines" in the forgings, which have caused the teeth to break. He further stated that heat treatment in many cases had caused internal strains that had resulted in sprung pinions after the teeth were cut. As these statements, and those of Mr. Sykes, appear to be contradictory, I would appreciate enlightenment on the subject.

Mr. Sykes states that the use of alloy steels for gear rims has not been practicable up to the present time. It has been my understanding that the British Admiralty has used nickel steel rims for some years.

Control of Superheat

By Thomas B. Stillman

An abstract of this paper is published on page 26.

Discussion

S. M. Robinson*: The various methods that the author has shown for controlling superheat have all been used by the Navy. As a result I am in accord with the author's statement that "the ideal way of controlling superheat is by means of separately fired superheaters." At

the present time, the principal disadvantages of the separately fired superheater are its additional weight and space requirements. With constant increases in steam pressures and temperatures, there will be the even more serious objection of running high-pressure steam lines the full length of the machinery compartments.

The type of controlled superheater shown in Fig. 17 is, by far, the best design that has been offered to the Navy Department to date. It offers a maximum of compactness, lightness, and ease of control. The secret of success with this type of boiler is the reliability of the automatic controls which are provided.

J. J. Nelis: As temperatures become higher superheat control will require something more than partial control, which is all that has been available to date or which is described in the author's paper. A separately fired superheater is the best method to obtain complete superheat control. Separately fired superheaters, when properly designed, can stand flame impingement.

A nearly flat superheat characteristic can be obtained with a combination of radiant and convection type superheaters in series. This combination can be obtained either in a boiler casing having both types of superheater or with a separately fired superheater.

W. W. Smith: For present steam temperatures around 750 degrees F., automatic control is not necessary, although it is desirable. For future temperatures around 950 degrees, it is essential to provide automatic control which is both accurate and reliable.

With respect to present temperatures, two tankers, which are now being built at the Federal yard, will operate at 400 pounds pressure and 750 degrees temperature. After thorough investigation, it was considered best to use a two-drum boiler with single gas flow. The furnaces are air and water cooled. Both economizers and air heaters are used, the designed efficiency being 87½ percent.

Except for the steam temperature, the boilers are fully automatic. The water, air and oil are automatically regulated with air-operated controls which maintain accurately the required conditions.

With respect to future temperatures we are now designing a machinery installation for 1200 pounds pressure and 950 degrees temperature. Preliminary investigation indicates that the best type of boiler for the purpose is similar to those of the new tankers, except for the following. The furnace is completely water cooled, and there is no air jacket. High-strength alloy steel is used for all pressure parts. High-temperature steel good for 1100 degrees working temperature is used for the superheater, which is of the two-stage type as shown in Fig. 7. An external main and auxiliary desuperheater, similar to Fig. 6, is used. The control of the boiler is completely automatic, including the steam temperature.

Professor Evers Burtner: This paper deals with oil-fired boilers. Pulverized coal would likewise lend itself to close temperature regulation. On the other hand, underfeed and chain grate stokers and hand-fired coal equipment are not as flexible and hence a lower total superheat temperature would be advisable in order to prevent excessive gas temperature in the superheater tube bank. I would appreciate a statement from the author as to the maximum superheat he would recommend for a coal-fired boiler with superheater, say four to six generating tubes above the furnace and without the damper control shown in Fig. 10.

J. R. McDermet: Mr. Stillman has, perhaps, placed too little emphasis upon the success of installations for superheating where the superheater is divided into two sections and partial desuperheating is performed between the sections for controlling the outlet temperature. This method has worked well in practice. It will be increasingly important in the future, as superheat temperatures are pushed upward, and superheater materials become increasingly abused. It has the additional advantage of rendering the superheat relatively independent of the boiler firing condition.

Closed type desuperheaters are used to a considerable extent in stationary practice, for reducing the temperature of steam where the initial superheat delivered by the boiler is not desired.

The submerged coil in the boiler drum is the simplest and most desirable for delivering moderate quantities of saturated steam.

Direct contact desuperheaters have been preferred in the stationary field, because of their compactness and low cost together with the satisfactory results they have given.

In the closed type desuperheater, some method of varying the heat transfer across the contact surface is necessary. This control may be obtained either by varying the water level in the desuperheater water storage space, thus varying the amount of transfer surface, or by regulating the pressure on the evaporated steam, thus varying the heat gradient. Both of these methods serve admirably when subjected to uniform flow rates, but are ill-adapted to regulation upon sudden flow changes, such as occur in maneuvering.

Lt. Comdr. D. L. Taylor, U. S. N.: In the section covering "Excess Air in Products of Combustion" the generality is made that, "The greater the excess air in the products of combustion for a given fuel the higher the superheat unless the superheater is of the strictly radiant type."

The superheaters of the Babcock and Wilcox sectional express boilers of some of our heavy cruisers are installed beyond the fifth row of tubes. In these boilers, at almost any given rate, change in CO_2 percentage from 11 to 14 scarcely alters the temperature or superheat more than one degree F. This is true also to a slightly less extent in the boilers for the new destroyers of the *Mahan* class. It is believed that the generality concerning excess air should be modified because the superheaters of these boilers are by no means strictly radiant. Less than one-half of the heat absorbed is taken by radiation when superheaters are installed beyond the fourth row of tubes, as in the case of the *Mahan* boiler, or the fifth row of tubes as in the case of the sectional express boilers of the heavy cruisers.

One of the statements under the heading "Separately Fired Superheater" is not entirely concurred with. Mr. Stillman states, "The gas-tight, water-cooled wall separating the saturated and superheater sides of the furnace is of the Babcock and Wilcox Company's stud-tube design having refractory surfaces exposed to the furnace which assist in maintaining the combustion efficiency in small furnaces available in marine work and also reduce the heat absorption per square foot of wall so that there is little danger of local overheating of the wall tubes even in the burner zone."

It is believed that stud-tube walls covered with chromic oxide rarely, if ever, are entirely gas-tight. Is it not true that the introduction of such a central wall tends to chill the furnace rather than to maintain combustion efficiency? Reduction of furnace temperature, particularly at low firing rates, occurs because a dividing wall tube absorbs nearly one-half the amount of heat of an uncovered A-row tube of the same size even when the stud tube is fully studded and thoroughly covered with chromic oxide; if half-studded, absorption becomes approximately two-thirds of that of an A-row tube.

C. J. Jefferson: It is felt that the definite values for the various factors affecting superheat temperature given by Mr. Stillman must be accepted with some reservation, as experience has shown that there is frequently a very wide divergence between accomplished and anticipated superheater performance; in fact, a difference of 150 degrees is not at all unusual.

It will be noted that in Fig. 3 a change in the percent of excess air from 18 to 31 percent is expected to effect a rise of 10 degrees F. in the superheat temperature. Recent boiler tests have shown that this relationship does not always hold true; in fact, such a change in percent of excess air in one case reduced the superheat temperature 2 degrees F.

High Steam Pressure and Superheat

By Charles P. Wetherbee

An abstract of this paper will be published in an early issue.

Discussion

J. K. Robison: In these days of limited size, the success of our Navy is largely measured by the amount of national defense we can supply in a ton of displacement. Where differences in detail may seem small, the fractions measure the difference between success and failure. We should not refrain from improvements because they can only furnish a mere 6 percent advantage. As time passes, with effective steam temperature control (perhaps available now) and with other advances in design we may bring about much greater savings than the considerable ones already achieved and the naval vessels of the future may confidently be expected to be much better than they would be if tied to a steam efficiency already fifteen years in the past.

W. W. Smith disagreed with the paper almost entirely, and advocated the Navy making an experimental installation for the highest temperature now possible, which is 1000 degrees or more. He believed that both merchant and naval machinery will progress to higher pressures and temperatures, and that better machinery and ships will result.

In support of his contentions he reviewed the present progress of steam machinery both ashore and afloat. For steam temperatures between 700 and 800 degrees F., there are a large number of installations both ashore and afloat. For temperatures above 800 degrees there are a considerable number of installations ashore and a few afloat. In all cases the plants are operating satisfactorily and are more economical than those of lower temperatures. He indicated that the best practice and the best economy for future machinery will be with temperatures between 900 and 1000 degrees, and furnished extensive data in support of his contentions.

S. M. Robinson: The author allows only 3½ percent difference in weight in favor of high-pressure installations. Our experience would indicate that this figure should be at least 10 percent, and the difference is increasing rather than otherwise.

Referring to the author's figure of 14 percent difference in steam consumption, in some proposals for naval vessels, a difference as high as 43 percent has been noted. Here, again, the differential is increasing.

As regards warships steaming very little at full power, it should be remembered that, regardless of the amount of time they steam at full power, this condition is the one that determines the size and weight of machinery installations and, therefore, is the determining consideration in any design.

The statement is made that superheated steam boilers have the disadvantage of sluggishness. I believe that the fact that ships with superheated steam get under way more quickly and change speed more quickly than ships with saturated steam will be confirmed by the majority of sea-going officers.

The author states that "reciprocating steam-driven auxiliaries, while simple and rugged, do not work well with superheated steam, because of the high temperature and dryness in the unlubricated steam cylinders." With this statement I am quite in accord, but I should like to add that, in my experience, this type of auxiliary does not work well with any other kind of steam. It seems to me that a turbine-driven auxiliary is, from any angle, the most satisfactory that we have ever had on board ship.

There can be no argument but what high-temperature steam offers more difficulty in astern turbines than does saturated steam, but means have been found to overcome this difficulty and it hardly seems one which should be given sufficient weight to govern the design of the machinery.

It would appear that at present, high-pressure, high-temperature steam provides machinery which is very much more economical than low-pressure saturated steam, takes up less space, less weight and is at least as reliable. The above advantages are increasing with time. The tendency toward the use of turbines and motors for auxiliaries has resulted in more reliable and economical auxiliaries and in reduction of space and weight.

Ernest H. B. Anderson: While experience in this country with high-pressure and high-temperature steam installations in naval vessels is limited, as further experience is gained it will be found that reliability of such installations will compare very favorably with the existing saturated steam machinery plants. Superheated steam has been in use in British destroyers since 1914, and recent reports have specifically referred to the increased reliability of these vessels.

It is difficult to appreciate the views of the author that a saturated steam installation using 300 pounds pressure, when compared with a corresponding installation of 400 pounds pressure and 650 degrees F. temperature, only weighs about 3½ percent more than the latter. In view of the large saving in steam consumption, I should expect a greater saving in machinery weights. As regards the disadvantages of high-pressure steam as expressed by the author, it seems to me that as further experience is gained the drawbacks cited will be overcome. Fuller consideration of the various factors brought forward by the author is warranted before abandoning so readily the economics of fuel consumption which he freely admits and which in turn add so appreciably to the steaming radius of the vessels.

A. R. Smith: The recommendation that Navy ships be built for 300 pounds saturated steam is certainly not conducive to progress and hardly seems to be justified by the advantages claimed for low-pressure, low-temperature steam over the high-pressure, high-temperature conditions. A large percentage of trouble and high maintenance on board ship has been due to wet steam, which is corrosive, carries suspended matter and cuts gaskets and joints, whereas the superheated steam has no similar destructive effect.

The low use factor of a warship at high speed may

not justify much additional cost or weight for economical equipment or high-pressure steam conditions from the standpoint of the evaluation of the fuel saved; but, if an equitable study were to be made with fuel at zero cost, the high-pressure, high-temperature plant capital cost should compare favorably with the low-pressure saturated steam plant, and when more commonly adopted may be less expensive and lighter in weight.

There is no sluggishness in picking up load in a high-pressure, high-temperature plant. The superheater in a modern watertube boiler is just as foolproof as any part of the equipment. Increased steam pressure does not decrease the natural circulation of water in a boiler. High-temperature steam does not necessitate the use of longer bends nor does it prevent the employment of slip joints. It is true that high temperature requires special materials but they are not difficult to obtain nor to work, and should not cause delay in construction or repairs, if intelligently employed by people of experience.

W. F. Schultz, Jr.: In the paper two principles are set forth, as follows: For merchant marine service, higher steam pressures and temperatures are more readily adaptable; for naval service, steam pressures should be limited to 300 pounds and no superheat, in the interests of dependability and simplicity.

In consideration of the first principle, the author has only to refer to current marine engineering literature. Every indication today points to the death and burial of the low-pressure, low-temperature steam plant from 300 pounds downward, in the merchant marine at least.

Naval vessels are designed primarily for combat efficiency, which means maximum speed with a maximum of military load, for the maximum cruising radius. They must also be designed for maximum economy in fuel consumption, maintenance and operating personnel for peace time operation.

Using boiler data presented in Commander Solberg's paper before the society in 1934, a fair comparison may be drawn. In a hypothetical destroyer for instance, with three *Pensacola* type boilers for 290-pound saturated steam, compared with four three-drum destroyer boilers equipped with economizers and superheaters, and operating at 500 pounds gage pressure and 725 degrees F. steam temperature for the same weight and space, it would be possible to provide about 16 percent more power at 70 percent of the saturated steam plants fuel rate, corresponding to a speed increase of about 5 percent at design power.

The advisability of limiting the propulsion machinery of new destroyers, cruisers and aircraft carriers to that which will give most economical fuel consumption at 12 to 15 knots, because of the uneconomical machinery in capital ships, the newest of which was designed in the Dark Ages of modern marine engineering, will seriously retard the progress of the Navy toward modernization—in fact will hold it to 1916-17 standards. The nearer we of the marine engineering profession can push the economical cruising speed to 20 knots, and provide maximum cruising range and ability to stay at sea at speeds between 25 and 30 knots, and in addition provide the speed that can carry our guns into action at nearer 40 knots, the more secure our nation will be. Based on what we have seen, this is not possible with 300-pound steam, in a 1500-ton destroyer.

Had the *Raleigh* a 500-pound 725-degree plant, her 12 Yarrow boilers could have been replaced with 8 three-drum destroyer type boilers and develop the same power for 24 percent less fuel at full power and 12 percent less fuel at 15 knots and 20 to 25 percent less boiler room space required. There would have been a considerable saving in machinery space as well.

The writer, in common with a majority of the marine engineering profession, believes that the steps the Navy has taken are in the direction of a thoroughly modern, efficient and economical engineering program.

J. H. King: In listing disadvantages of higher temperatures, the author refers to "sluggishness, requiring longer time for a given increase in speed of the ship primarily due to the presence of superheaters, etc." If this has resulted, is it not due to the design of the installation rather than to the higher temperatures?

The author refers to "complication in the construction, operation and care of the boilers due to the pressure and superheaters." Engineers experienced in the operation of properly designed higher temperature superheaters handle them without trouble and without any feeling of complication at all.

It may be true that boilers operating at higher pressures are more liable to corrosion and scale deposit for a given feedwater condition, than lower pressure boilers. This, however, is readily overcome by proper feedwater treatment. Extensive experience with boilers having natural circulation indicates quite the contrary to the author's feeling in regard to the effect of higher pressure. The other disadvantages listed by the author are no doubt correct. However, it is felt that further experience and advances with materials, particularly metals, will greatly lessen, if not entirely eliminate, these difficulties.

Whether or not high pressure and superheat will prove advantageous and reliable in a warship is a question that time will answer. Insofar as boilers and superheaters are concerned, there can be no question, as experience in marine work and very extensive experience on land have amply demonstrated the advantages of higher pressures and temperatures.

Captain C. A. Jones: Although the use of high-temperature steam in marine practice is not new, it appears now to be well established in all current construction. This applies also to naval construction of the last three years as well as to merchant marine practice. Proper selection of materials and correct design should insure reliability equal to that of the saturated steam boiler when the superheater is an integral part. Any complication in the construction of the boiler necessitated by the incorporation of the superheater is overcome by the numerous advantages accruing incident to its use. No added difficulties in operation are being experienced.

Sluggishness is a non-existent factor when it is considered that some of the boiler superheater units being employed can be fired safely from the cold condition to the full temperature condition in a maximum of 45 minutes under the most adverse conditions and that a reasonable evaporation rate under these conditions can be established within that limit. Up to the present time no reports of slowness in large speed changes have been received.

The principal advantage of using the present pressures and temperatures resides in the possibility of thereby installing in the space available the powers demanded for present ship characteristics. With a 70 percent increase of power installed in ships but little larger than their prototype and with the demand for space and weight conservation even greater than heretofore, it is certain that the 300-pound saturation plant would be an impossibility. The improvements of plant arrangements and machinery designs for the new conditions have fully justified, in my opinion, the adoption of higher pressure and temperature designs.

Measuring Vibrations in Propeller Shafting

By Dr. William J. Muller*

ABSTRACT

With the usual long base torsionmeters measurement of torque in rotating shafts is made at one end of the base length, the position of the other end being transmitted to the place of measurement in some way or other, which requires the complication of an adjusting device for setting the finder. In this paper a long base system, developed by the author, is described in which the difficulty of the adjusting device has been eliminated. This has been made possible by taking measurements at the two ends of the measuring length instead of at one end, thus doing away with the transmitting device from one end to the other.

The principle of the system involves the use of two graduated disks placed at the ends of the base length of the shafting over which the torque is to be measured. The position of the two rotating disks relative to two fixed points is observed simultaneously by means of a stroboscope of simple design. Two vacuum tubes connected with the secondary circuit of a transformer are connected in series with an adjustable spark gap which serves as a damping device for the electrical oscillations during the discharge. Exposures of 0.00001 second or less are obtained without difficulty.

The primary of the transformer is connected with an adjustable interrupter which is worked by cams placed on the shaft. By placing the interrupter under one of the cams the primary circuit of the transformer is broken once at each revolution of the shaft and the two vacuum tubes are lighted simultaneously during a very short period, which enables the observers placed at the two disks to read the position indicated relative to the fixed points.

As it is thus possible to read the relative position of the two measuring disks in one position of the shaft, it is also possible to take readings at different positions of the shaft by putting 8, 12, 16, 24, etc., cams on the shaft and shifting the interrupter after each reading to the next cam. As the readings taken as described cover a number of revolutions made during the whole series of observations, they give an average picture of what is really happening in the shaft as regards the variation of torque. Under favorable circumstances, that is, if the engine is running at constant speed and with a smooth sea, the average torque curve appears to be practically identical with actual torque during one revolution.

Illustrations are given in the paper of the application of the system to Diesel and turbine-driven vessels.

Besides visual records, it has been possible to make photographic records with a torsionmeter device based on the same principle and only modified to answer the purpose; that is, photographing different positions of the shaft at two places simultaneously during one or more complete revolutions.

Frahm in his classic paper on "Harmonic Vibrations and Dynamic Phenomena in Ship's Propeller Shaftings," in 1902 for the first time mentioned the relation between the resistance, speed and damping effect of a propeller. Dr. Muller shows how the damping coefficient in Frahm's formula can be calculated from results of measurement applied to theory. While the results given in the paper may be regarded as a contribution from practical experience to the knowledge of damped torsional vibrations, it does not yet justify alteration of views and principles as long as it has not been confirmed and completed by more experience.

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DISCUSSION

PROFESSOR FRANK M. LEWIS: I would like to question the author regarding the accuracy obtainable with this mechanism. In Table 1 the torsion has been determined to the nearest hundredth of a degree. The diameter of the measuring disks is not stated. Assuming a disk 2 feet in diameter, $\frac{1}{100}$th degree would be a circumferential distance of $\frac{2}{1000}$ inch. What is the diameter of the disk and what reading devices are used to obtain data of this accuracy?

In the second part of the paper Dr. Muller has some difficulty in reconciling the observed resonance curve with one computed by Frahm's theory. As noted by Dr. Muller the M limit curve lies below the observed resonance curve over a part of the range, which is clearly impossible on the basis of the theory. This would seem to indicate that the values of the harmonic coefficient obtained from indicator cards used in computing the M limit curve are too low. An increase in the values of the harmonic coefficients would also bring the observed and theoretical r values into much better agreement. It may be pointed out that the 30 percent allowed for the mass of entrance water is open to greater uncertainty than the damping coefficient and a change in this may have a considerable effect on the results.

COMMANDER H. E. SAUNDERS: For those interested in the development and use of torsionmeters, it would be of great benefit to have Dr. Muller add some information relative to the following features:

(a) What is the diameter of the graduated disks or drums, relative to the outside shaft diameter?

(b) With shaft measurement lengths of the order of 100 feet or more, are the shafts calibrated for torsion after assembly in the ship, or are the torsional deformations calculated?

(c) If calculated, what methods are used for calculating the torsional deformation of the couplings?

(d) What experimental verification is there for the assumption, if such is made, that the bolted faces of the flanges have the same torsional rigidity as the solid material?

(e) Where and to what are the zero markers D and E secured, to insure that there is no relative displacement between the two when the vessel is under way?

(f) What methods are employed to insure that friction in the bearings in the measuring length of shafting is neutralized or overcome when taking the zero readings?

R. A. MILLER: To determine horsepower by this method with negligible error requires a large number of readings. It would appear that fairly close results for ordinary service observations could be obtained by carefully plotting the trial trip data, and determining the points on the shaft where the average power is indicated. These points could be determined for various speeds. By setting the breaker at the angle suitable for the speed, fairly close power observations could be obtained by single readings.

The author states that the values of ø have not been used because of the time lag inherent with indicators. Could not this difficulty be overcome by having the electrical contacts actuated by the crosshead, or some other suitable part of the engine, instead of by the shaft, as at present? The exact position of the pistons should thus be known in relation to the torsion angles under consideration.

Propeller Vibration

By Frank M. Lewis*

Abstract

Vibration generated in the hull of a ship by the action of its propellers is of two types:

Unbalance vibration, of once per revolution frequency, which is induced either by mechanical unbalance of the propellers or inequality between the blades; or

Blade frequency vibration, having a frequency equal to the revolution times the number of propeller blades, or a multiple of this, which is induced by hydrodynamic reactions between the water, the propellers and the surface of the hull in their vicinity.

Unbalance vibration can be avoided by propellers having satisfactory balance and equality between the blades. Blade frequency vibration offers a more difficult problem and is present in practically every propeller-driven vessel. The problem of the elimination of blade frequency vibration may be approached from several viewpoints; we may consider—

(a) The conditions at the propellers which induce blade frequency forces, with a view to making these forces as small as possible;

(b) The hull characteristics, with a view to avoiding resonant conditions;

(c) Special devices, such as synchronization, dynamic vibration absorbers, etc.

(b) and (c) are discussed briefly but the paper is primarily concerned with the study of the hydrodynamic propeller reactions.

Apparatus and test procedure have been devised for measuring the propeller forces of blade frequency in self-propelled models, thus making it possible to investigate the effect of various factors, such as tip clearance, form of bossing, etc., upon these forces. Tests have been made at the Washington tank upon the model of a 630-foot ship.

The total vibratory forces acting upon the ship may be considered as composed of a part acting directly on the hull surface, designated as surface forces, and a part which acts on the blades and is transmitted to the hull through the propeller bearings. This is designated as bearing force. The bearing forces are the result of the irregular wake in which the propeller operates and a theory is developed for their calculation.

It is shown that for the model tested the surface forces are the predominant factor, and that the model behaves exactly as if the propeller suction were of a pulsating character, with a maximum downward suction occurring at the instant the blade tips are at closest approach to the hull. A theoretical study of this pulsating suction, in the case of a propeller operating parallel to an infinite plane wall, has been made by means of an electrical model of the propeller vortex field; but it is shown that neither the observed vibratory forces nor measured thrust deduction can be accounted for on this basis.

Various hypotheses are advanced to account for the observed thrust deduction and vibratory forces but any final solution must wait on further theoretical and experimental studies.

Discussion

Commander H. E. Saunders suggested that the author try a variation of conditions frequently encountered in ships in an endeavor to arrive at a better agreement between the measured blade frequency forces on the model and the calculated forces by increasing the thickness of the boundary layer. If a vessel has been out of dock for some time, a rather severe amount of vibration is experienced in the vicinity of the propellers; but if the vessel is docked and the bottom cleaned, the vibration practically disappears or it returns to the normal amount. He suggested that this condition might be duplicated in the model by adding wire screening to the surface increasing the thickness of the boundary layer and thus arriving at a better agreement between the two.

Charles F. Bailey reviewed the inception of the investigation on propeller vibration and called attention to the encouraging progress thus far made.

A. L. Kimball: A point which remains to be cleared up is how great is the transverse component of the exciting force from the unbalanced propeller blade pressure reaction on the stern, when the up and down component has been reduced to a minimum by proper propeller phase control. It was shown clearly by tests that the up and down component was a minimum when the blades were 60 degrees apart in phase relation. It is stated, apparently without experimental demonstration, that with this phase relation the transverse component was a maximum. How great is this maximum compared with the measured up and down maximum? If it is less by a considerable amount it would seem that an effective means of holding twin propellers in the 60 degree phase relation would assume material importance.

It has been pointed out to the writer that in a recent effort by the author to reduce this type of vibration, the twin propellers were actually held in phase to within one or two degrees instead of being held 60 degrees apart. This would suggest that the transverse vibration exciting force may be worse than the vertical.

E. K. Roscher called attention to the value of the Kort nozzle as a means of eliminating vibration due to the action of propellers, as it has a strong natural tendency to equalize the speed and direction of the water before it enters the propeller disk. Cases were cited where on vessels fitted with Kort nozzles vibrations due to propellers were eliminated.

Dr. Gunther Kempf: Professor Lewis' paper is one of the best works in the field of research in naval architecture that has been contributed in recent years, and is of great importance for the future. We must look forward to further investigations which should be made on the ship itself, to determine the relationship between the forces measured with the model and with the ship. Even now, the results indicate that it will be possible to connect the irregularity of flow to the propeller quantitatively with the magnitude of the vibrations to be expected.

The division of the wake shown in Fig. 13 does not suffice for this determination. A reliable determination of the wake structure requires about 150 to 200 measurements, both without a propeller and with a propeller working under various loads.

Nevertheless, it appears to me that these results will depend to a very great extent upon the local form characteristics of the ship concerned, so that the results given can not be generalized quantitatively. These will always depend upon the extent of the irregularities in the arriving current.

The part played by the bearing pressure is unexpectedly small as compared with that by the surface pressures. From Dr. Graff's calculations (Jahrbuch der Schiffbautechnischen Gesellschaft, 1931) variations of

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the axial and tangential propeller thrust of about 8 percent of the average thrust occurred for a certain case with a four-blade propeller and 20 percent with a three-blade propeller, because of the given dissymmetry of the arriving current in the axial and tangential directions. Forces of this order of magnitude must also have been effective as forces reacting on the bearings. To be sure, it is possible that they were damped in the bearing. It would be interesting to repeat the investigations with four-blade propellers.

Dr. J. Lockwood Taylor: This paper breaks fresh ground both on the experimental and theoretical sides. The conclusion drawn from the model experiments that the varying suction produced on the hull by the screw, usually regarded as a secondary effect, is the principal source of propeller vibration is certainly surprising. On general grounds one would not expect that the pulsating force applied to the hull would be many times greater than the variation of load on the propeller blade itself, as appears to be the case. Accepting the large pulsating pressure as an experimental fact, it should follow that the ship vibrations produced would be greater in the horizontal direction than in the vertical, since the pressure acts normally to the hull, and has a large horizontal component. The cancelling effect due to widespread distribution would, however, be even greater for the multi-node vibration of the ship than for the two-node vibration of the model. As regards the difficulty which the author mentions in calculating the hull pressures from the Prandtl theory, it would be interesting to know whether he has considered the possibility of applying the simpler Goldstein theory, which appears to give excellent results in the prediction of propeller characteristics.

As regards the possibility of predicting hull frequencies, and the value of the prediction, it must be admitted that so far as the multi-node types are concerned, much more experimental data than at present exists is required before a confident prediction can be made. Elimination or reduction of the impulses producing the vibration seems to be the most hopeful line of attack.

Theodore L. Soo-Hoo: I note Professor Lewis' statement that stiffening of the struts, bossing or stern structure of a vessel would not lessen vibration. Having seen vessels, designed for maximum lightness, in which extra heavy framing was built in way of propellers and struts (in one case, deep flanged plates were welded to existing transverse frames), I am wondering why it was done. Was local drumhead vibration, caused by pressure variations, thus reduced, or was this just useless weight being carried around by the ship? Admiral Rock has stated that additional stiffening of strut supports and after plating of treaty cruisers was effective in reducing local vibration which was probably caused by cavitation.

Professor Evers Burtner called attention to the case of the destroyer *O'Brien* which while operating at 29 knots on its trials in 1915 had difficulty with the shell plating opposite the propellers. The plating tore out on one side and cracked on the other opposite the propeller tips and at some distance from the fastening of the propeller struts to the hull. This indicates a surface and not a bearing force and that the vibration and forces must have been severe. He suggested tests of the *Hoover* model with the bossing carried aft to give the effect on vibration of tip clearance only instead of tip clearance plus longitudinal clearance between the leading edge and the bossing.

Captain William McEntee: If you imagine each propeller blade to be a very strong magnet, you get a picture of what happens when the blade passes the hull of the ship. A great part of the loss of energy in a propeller comes from the vortices at the tips. We all know what an enormous pressure is developed in a typhoon as the air gets closer to the center of the vortex. When you consider that water is more than 800 times as heavy as air, you can get some idea of the enormous forces developed.

New Studies in Ship Motion

By P. R. Bassett and F. P. Hodgkinson*

Abstract

During a period of about two years we have had the opportunity of studying the action of the *Conte Di Savoia* in all kinds of seas. Stabilization of this ship has proven successful and all contractual requirements were satisfactorily met. Further studies, however, were requested by the Italian Line to determine the cause of occasional large angles of inclination occurring in synchronism with the residual stabilized roll and generally lasting only two or three oscillations. During the course of these studies we observed the action of various other ships and found that their motions confirmed our findings.

Our paper is confined almost entirely to the essentials of cause and effect. So far as we know, this is the first time that any mention has ever been made of the fact that all periodic inclinations are not roll.

The action of a quartering sea on a ship causes it to yaw from side to side at a rate dependent upon the sea intensity, the accuracy of steering, and the natural course steadiness of the ship. The period of yaw is usually of about the same magnitude as the rate of wave encounter. For simplicity we may consider the ship as having a sinuous forward motion consisting of a series of turning circles whose radii are dependent upon the rate of turn and speed of the ship.

In the usual design of present-day ships the center of gravity is considerably above the center of the vertical water plane. Consequently, each yaw causes a centrifugal force which manifests itself in heeling of the ship, or causing what we have termed "yaw-heel." Unfortunately, the direction of this yaw-heel invariably augments the normal rolling and will even cause rolling when theoretically none should exist. We believe this is why some ships, for no apparent reason, have turned out to be notorious rollers.

All authorities on rolling agree that, if the period of wave encounter approximates the natural rolling period of the ship, the ship will roll to very large angles. A consideration of this theory will convince one that, if the ship's period be of at least 26 seconds, the zone of sea directions which would cause heavy rolling is comparatively narrow. Consequently, the longer the ship's period, the less opportunity the ship will have for developing heavy rolling.

As a result of our studies we have attempted to outline the requirements for a more naturally comfortable and steadier ship than that of usual design. The principal requirements are that the ship must have a long period of roll and a low center of gravity. The problem of steering must also be considered with the purpose of reducing yawing to an absolute minimum.

While we do not presume to say that a ship can actually be designed precisely in accordance with these re-

* Sperry Gyroscope Company, Inc., Brooklyn, N. Y.

quirements, we do feel that improvement in sea qualities can be obtained if attention be paid to these recommendations.

Discussion

Lieut. M. E. Serat: The statement that "irrespective of the period of wave encountered against the ship the period of roll produced corresponds closely to the natural period of oscillation of the ship" is not in accord with naval observations taken at sea or with the results of many experiments on the rolling of models, all of which indicate that ships do not roll in their natural period but are forced to roll more or less in the apparent period of the waves.

The formulae for amplitude of roll are developed from the assumption that the rolling is unresisted. All ships have damping resistance, hence equations of undamped roll can never be applied to actual practice.

In the analysis of the yawing motion the authors assume that as soon as the ship starts to yaw she will move out of the original course on the arc of a circle. As a matter of fact a ship in starting a turn either from yaw or rudder action will continue in actual motion along her original course to a great extent rather than in the direction the bow points, while the bow swings from the original course to the new heading. This action results in the motion of the ship contributing more advance and less transfer than would be the case if she followed a circular arc as assumed in the paper. The effect is the same as though the ship moved on an arc of considerably greater radius. Thus the centrifugal force and heel would be less than calculated in the paper.

It would appear that the yawing moments might at times be considerably increased by the operation of the stabilizing gear over those which would prevail on an unstabilized ship. It would be of interest to have course record curves taken simultaneously with the rolling records.

The heel encountered during yaw is due to the combined effects of: wave slope, centrifugal force due to yaw, and combined yaw and pitch. The authors suggests that the *CG* of a ship should be as low as possible to minimize the heel during yaw due to centrifugal forces. This would necessarily increase the *GM*. Both the lowering of *G* and the increase of *GM* would reduce the damping of roll characteristics of the ship, which seems an undesirable action. They further suggest that long period might be obtained by locating weights remote from the longitudinal centerline. The locations of the principal weights are determined by other more vital considerations generally. They also suggest that heel could be reduced by lowering the rudder, but while pressure on the rudder does oppose the centrifugal force during a turn, it appears that heel due to yaw is increased by putting over the rudder and that lowering the rudder would make matters worse.

E. H. Rigg: All ships are compromises, and easy rolling and safety are somewhat antagonistic. In designing ships it becomes important to equate rolling and stability in such a way that safety in intact condition, safety in damaged condition, and rolling (intact) are so balanced that we have a ship both safe and comfortable to the greatest practicable extent. By assessing the ships natural period of roll against the maximum probable wave periods for different routes we can design for such stability characteristics as will give the best average answer to the complex conditions.

For the North Atlantic passenger lanes the weather characteristics are about as follows:

Beaufort scale	Weather	Percentage of the time (year) prevailing	Approximate corresponding wave periods in seconds
Over 8	Gales and storms	14	over 9
7	High winds	20	7 to 8
5 and 6	Strong breezes	22	6 to 7
1 to 4	Light breezes	38	under 6
0	Calms	6	—

The table gives a background against which to assess stability and rolling characteristics. These figures apply only to the New York Channel Port run and should not be used in the case of the *Conte di Savoia* on the New York-Mediterranean route, on which considerably easier average conditions prevail. Some typical routes have been analyzed in the manner indicated above:

Route	Percentage of the time in which gales of Beaufort 8 and above prevail
San Francisco—Honolulu-Sydney	1.3
San Francisco—Yokohama	7.3
New York—Gibralter	7.5
Cape Town—New Zealand	14.5

If our stability and rolling endeavors are to be pushed to logical conclusions, it would appear that a stability meter should be placed on typical new vessels, particularly those carrying large numbers of passengers. Such an instrument need not stay aboard any one ship after all her working needs have been tried out.

Henry W. Bengston: The attempt to control the rolling and pitching characteristics of a ship under design amounts to nothing more than a discussion of what her period will be after the basic requirements of stability and damage stability are filled. The latter often requires a large metacentric height because of the length of compartments that can be flooded, and since the variation of inertia and displacement generally is very limited, the metacentric height is the principal governing factor in the period expected during rolling. The smaller the *GM*, the easier the rolling. The conflict is between comfort and safety, and naturally comfort must give way to safety. The problem of comfort is one for the owner rather than the designer. It is his also from the standpoint that efficient and intelligent use of the ship counts as much as or more than design qualities.

From observations one often finds that discomfort on board transatlantic liners begins when the period drops below 20 seconds; if the roll is not harmonic, or nearly so, it begins sooner. This is, however, in itself no criterion, because the accelerations accompanying this roll are seldom known. The angular acceleration can be estimated, and assuming a pitching angle $\frac{1}{6}$ of rolling angle and pitching period $\frac{1}{2}$ of rolling period it would appear that repeated accelerations of as little as $0.1g$ might cause discomfort. Practical observations on board ship along this line would be of value.

James A. Pennypacker: If the authors of this paper were naval architects, some of the value of the paper would be lost for they would probably not have the temerity to propose as a general standard that "the natural still-water free period (of roll) should be not less than 26 seconds for a complete period." For instance, for a 400-foot vessel which displaces 6800 tons and whose radius of gyration is 19.5 feet to have a minimum period of 26 seconds for a complete roll, her *GM* must be less than 0.7 foot. Such a low *GM* affords little margin of safety against loss of stability. Considerations of safety and of weight distribution preclude the attainment of a roll period of 26 seconds in general practice.

John P. Comstock: The present standards for large passenger liners of this country render a 26-second period practically unattainable. For a given degree of comfort, the period should not be any given length of time, but should increase with the dimensions of the ship.

Marine

ELECTRIC POWER—XXII

By Captain Q. B. Newman

Engineer-in-Chief, Retired, U. S. Coast Guard

In Fig. 75 we showed the condition of a leading current; that is, a current which is ahead of the voltage which produces it. This condition is similar to a wheelbarrow leading the man who pushes it. We found that this results in a leading power factor which is useful in neutralizing the lagging power factor of induction motors, but which is otherwise undesirable. We are now ready to examine the cause of a leading power factor.

Armature Reactions in Alternating-Current Machines

Reviewing briefly the operation of a synchronous motor, we have an alternating voltage impressed on the stator windings, the alternating voltage produces an alternating current in the stator windings, and the alternating current produces magnetic poles around the stator. The poles build up in the three phases in regular sequence, giving us the effect of a rotation of poles around the stator. The rotor has a system of N and S poles bolted around its rim, these poles being created by the direct-current excitation in their coils. As the stator

Fig. 131

Fig. 132

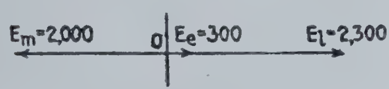

Fig. 133

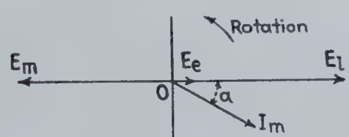

Fig. 134

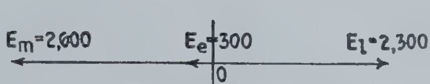

Fig. 135

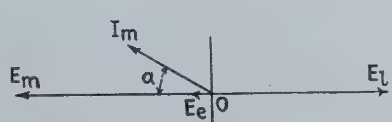

Fig. 136

poles rotate around the stator, they drag the rotor poles along with them, and so the rotor revolves.

By Lenz's law, we know that as the lines of force from the rotor poles travel around with the rotor they cut across the stator windings and induce a voltage in the stator windings. We call this voltage counter *e. m. f.* and it is opposite in direction to the voltage impressed on the stator windings by the power cables. We therefore have two voltages in the stator, just as we had in the armature of the direct-current motor, viz., the impressed voltage from the line, and the counter *e. m. f.* induced in the machine by its own rotation.

Here is a beautiful job for vector analysis.

Let us say our line voltage, E_l, is 2300 volts, represented by a vector, as in Fig. 131.

Let us say our counter *e. m. f.* (E_m), in the stator windings is 2000 volts represented by a vector in the opposite direction, as in Fig. 132.

Since both voltages are in the same stator coils, we can combine Fig. 131 and Fig. 132 so as to find the effective voltage which causes current to flow. This is done in Fig. 133, and we find the effective voltage, E_e to be 300 volts.

We know the inductance of the stator windings is high, and therefore that the current will lag behind the voltage E_e, which produces the current. Fig. 134 shows what might be expected, with the current I_m lagging behind the voltage E_e, and also behind the line voltage E_l.

Now suppose that we over-excite the rotor field and thereby increase the rate of cutting of lines of force by the stator coils. We could in this way make the counter *e. m. f.* as large as we please. Suppose we made it 2600 volts, but keep our line voltage steady at 2300 volts as before. The vector diagram in Fig. 135 shows that the effective voltage E_e is now in the other direction. The current, I_m lags behind the effective voltage, E_e, which produces it, by the same angle, as shown in Fig. 136, but we now observe that the current is actually ahead of the line voltage E_l, and we have a leading power factor.

It is therefore clear, and you can verify it by varying your motor field rheostat, that there is one certain strength of motor field that will cause the current to be in phase with the voltage; with this proper excitation the power factor is 100 percent. With an under-excited field the current will lag, and with an over-excited field the current will lead; in either case the power factor will be less than 100 percent, decreasing as the excitation gets further away from normal. And we have already seen that for a constant load condition, and a constant line voltage, if the power factor is decreased the line current must increase to satisfy the power formula

$$K.\,W. = \frac{1.73\,E\,I \times P\,F}{1000}$$

We have the smallest possible current when the power factor is 1.00. If we decrease the excitation and produce a lagging power factor, the current will increase. Also, if we increase the excitation and produce a leading power factor, the current will again increase. This can be plotted in a curve called the V-curve of the synchronous motor, the general shape of which is about like Fig. 137.

We are now in a position to see that the change in direction of the vector E_e is due to the armature re-

action of the motor. The actual magnetic field in the air gap of the motor is a combination of the rotor field and the stator field, just as it was in the direct-current generator. When the current I_m lags behind the line voltage E_l (see Fig. 134) the field of the stator has a cross-magnetizing effect and also a demagnetizing effect.

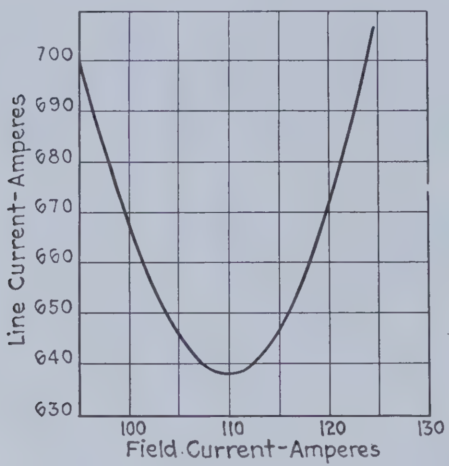

Fig. 137

But when I_m leads the line voltage E_l (see Fig. 136) the field of the stator, while it still has a cross-magetizing effect on the rotor field, now adds to the strength of the rotor field, and thereby increases the counter *e. m. f.* to a value greater than the line *e. m. f.* (E_l). It is apparent, therefore, that it is possible to increase the motor field (over-excite it) and reduce the generator field (under-excite it) without changing the voltage of the system; or to hold the generator field normal and raise the voltage of the system by over-exciting the motor. So it is necessary to adjust the two fields together so as to obtain the desired voltage when the current is a minimum as shown by your *V*-curve.

If you are afflicted with an induction motor for propulsion, about all you can do for the power factor of the system is to regulate your voltage so that the motor takes the manufacturer's full load current rating when the motor is working at full power.

(*To be continued*)

Nickel Has Wide Use in Marine Industry

In a 1935 survey of the nickel industry, Robert C. Stanley, president of the International Nickel Company of Canada, Limited, Copper Cliff, Ontario, refers to the use of metal products in the marine industry as follows:

At sea, as on land, the problem of reducing deadweight during 1935 has received growing recognition. Because of the corrosive action of salt water, rust is a real problem in maintaining essential factors of safety. Thus the desire to reduce weight through use of thinner sections has stimulated interest in monel metal, stainless steel and other nickel alloys for shipboard installations.

Among the developments in this connection was the introduction of monel metal water tanks for lifeboats. Several large steamship companies adopted a general policy of making such replacements. Even small boat owners evidenced interest in this development, and for the first time monel metal tanks for both fuel and water were made available for yachts and small cabin cruisers.

Monel metal was also employed for various parts of ship power plants exposed to contact with salt water. Increased corrosion resistance and a saving of approximately 35 percent in weight were effected through the use of welded condenser heads made of monel metal sheet. Purity of boiler feed water was increased by the adoption of surge tanks similarly constructed.

"K" Monel wearing sleeves on shafts of centrifugal pumps and cast "S" Monel valve trim for vital parts in the heads of soot blowers came into general use.

In boiler settings, Inconel anchor bolts have been adopted for holding refractory fire brick in wall construction.

The present trend in the marine field is to circulate boiler feed water, steam and condensate in a closed system. The desirability of minimizing contamination from corrosion has led to the consideration of corrosion-resistant materials for storage and deaeration tanks of the boiler feed-water system. Monel metal has been chosen for this and was installed in several vessels built and building. Lightness was sought through the elimination of allowance for corrosion during the life of the tank, and it was possible to use plate only one half as thick as the carbon steel formerly used. The need for painting the inside of the tank was also obviated.

Also to reduce weight, monel metal has been employed for the water chests or heads of marine condensers in several vessels built or building. This application required the development of a special technique in handling $\frac{3}{16}$-inch monel metal plate by coppersmithing methods to obtain intricate shapes. Fabrication involved new problems in the welding of heavy sections of monel metal.

Pump designers and operators have been led by experience to seek corrosion-resistant alloys and greater hardiness for pump rods, sleeves and bushings. A number of large boiler feed and main circulatory pumps for ships have been built during the past year, using "K" Monel for pump rods and bushings.

Increasing use of cupro-nickel alloy for condenser tubes, a standard application for marine service in Europe and the United States, was observed during 1935. Copper nickel condenser tubes may be of either the 70 copper-30 nickel alloy or, in some cases, 80 copper-20 nickel. Several vessels are being built with pipe line of the 70-30 alloy to handle circulation of salt water. Practical experience confirms laboratory investigation and indicates exceptional life for such service.

The wide use of nickel for marine purposes is illustrated by the *Normandie*. This French liner has nickel-chromium steel turbine blading, 2 percent nickel steel for bolts and studs on high pressure superheated steam lines and 5 percent nickel steels for expansion joint fittings. The shafts are of nickel-chromium steel. Chromium-nickel stainless steel of the 18/8 type was used for decorative fittings, hardware and finishings, including bath fixtures, moldings, lighting fixtures, beds, modern furniture, galley equipment, metal ware, railings and the name on the bow in letters three feet high. Nickel silver was used for plumbing fixtures and allied items. Monel metal went into valve trim, turbo-feed pump blading, disks and valves, refrigerator trim, etc. Auxiliary condenser tubing was made of 70-30 cupro-nickel. Nickel alloys will be used extensively in several ships now building or soon to be built in France.

During the year a large hollow nickel-steel wheel shaft was forged for the stern paddle wheel of the steamboat *Sprague,* now plying between Baton Rouge and Memphis on the Mississippi River and said to be the largest river steamboat in the world. The paddle wheel shaft was of 3¼ percent nickel steel, hollow forged. Its shipping weight was 78,305 pounds; overall length was 47 feet 2 inches, outside diameter 31 inches, and inside diameter 21 inches.

Handling Perishables from Cuba

By F. B. Crocco*

Transporting fruits and vegetables during the winter months from Cuba to consumers on the Eastern seaboard presents an interesting problem in refrigeration, cargo-handling and heating. The vegetable season usually starts in December and is partly over in May.

In Havana, on the morning of the semi-weekly arrival of our crack passenger and freight liner, one may observe at our terminal gates, a seemingly endless line of trucks loaded with fruits and vegetables, destined for New York. These vehicles, both horse-drawn and motor, convey to the terminal a most assorted variety of fruit and vegetables—hampers of lima beans, okra, string beans; crates of peppers, avocados, eggplants, cucumbers, grapefruit, pineapples, bunches of plantains; and most of all, big boxes of tomatoes.

The vehicles come from farms and packing houses some forty or fifty miles outside of Havana, and bring in about half the vegetable shipments, which average between 20,000 to 25,000 packages for each ship. Our record vegetable shipment last year on one vessel was over 55,000 packages.

Freight cars, which usually arrive at the terminal during the 18-hour stay of the vessel, bring in about one-fourth of the entire shipment from outlying districts some 200 miles distant.

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* Terminal department, New York & Cuba Mail Steamship Company.

Transfer of vegetables to ship's refrigerator by tractors over gangplanks avoids damage to the product through manipulation

Ward Line pier, 120 feet wide, permits transit of railroad cars. Freight can be loaded directly from cars to ship's holds

On the day preceding the arrival of the ship, the lima beans, some okra and at times other vegetables are sent to our pre-cooling plant on the terminal. These products make up the remainder of the vegetables on each ship. The pre-cooling facilities consist of twelve compartments each capable of housing 5000 lugs of tomatoes, or 3000 hampers of lima beans.

The brine spray system of refrigerator is used very successfully in this plant.

Our cement covered pier, which extends 530 feet into the bay, is 120 feet wide and has 22-foot aprons on each side. The sliding doors, while not the continuous type, open sufficiently to facilitate loading and discharging of side ports and overall hatches.

The cargo capacity of the ship is 350,600 cubic feet. It may be divided into two classes—the non-insulated spaces, which occupy 237,400 cubic feet in five hatches (three forward and two aft); the insulated spaces which occupy 113,200 cubic feet in two hatches (one forward and one aft).

The forward insulated spaces, divided into three decks, are refrigerated by means of air driven past brine pipes into one side of the compartment and sucked out the other side. This action may be reversed from time to time.

The after insulated compartments are divided into three decks, two of which are refrigerated by means of brine pipes. The third deck is cooled by means of air driven through brine spray into one side of the deck and drawn out at the other side.

The non-insulated compartments are mechanically ventilated and the foul air is mechanically drawn out, giving the vegetables stowed in non-insulated compartments the benefit of outside air temperature and perfect circulation of that air.

When the vessel is alongside the pier ready for loading, eight side ports and two overall hatches with 52 and 56-foot booms may be used to facilitate and speed the work.

The general cargo may consist of bundles of hides; bales of tobacco, sponges and rags; bundles of cedar board, or cases of liquor. Large consignments of hides usually come alongside in lighters and are hoisted aboard in net slings into No. 1 hatch. The remaining general cargo, which is usually on the pier when the vessel arrives, is brought to the side ports by means of trailers and tractors. There it slides into the holds by means of roller or conveyor belts.

All the pre-cooled fruits and vegetables are loaded on flat trailers and drawn to one of the after side ports by gasoline and electric tractors.

At the side port, the bottom of which is usually three to four feet above the dock, the longshoreman passes the package into the port directly onto the roller conveyor. This conveyor, by means of gravity, carries the package to the hatch combing.

The skid-conveying system is employed in most of the hatches whenever it can be used in connection with a side port. Very often trucks will be backed to any of the four side ports aft and their contents will quickly disappear over the roller conveyors into the hold. A truck load of 250 lugs of tomatoes can in this manner be easily unloaded in 25 minutes.

Freight cars which can easily be switched to the ship's side usually carry about 600 boxes of tomatoes. When in position the distance between the side port and the car door can be spanned by a section of roller. It is then an easy matter to unload the entire car over the rollers into the ship.

The 'tween decks forward are loaded either through No. 2 side port, which is well above the pier, by means of the belt conveyors, or through a lower side port which is reached over a skid. It is 32 feet in length and 8 feet wide and spans the distance between the dock and the ship. A train of trailers loaded with lugs of tomatoes is drawn to the skid and the lugs are pushed aboard over rollers or hand trucked to the deck of the ship. The cargo may be trucked into No. 1 or No. 3 hatches through doors in the bulkhead.

Throughout the entire cargo spaces, considerable care and ingenuity was shown by the designer in that all ventilators, stanchions or obstructions of any kind were built along the sides or at the bulkheads.

During the northbound voyage of the vessel from Havana to New York, which in moderate weather is accomplished in 58 hours, considerable care is exercised to protect the fruits and vegetables. The air temperature of the insulated compartments is registered mechanically on gages in the ice-machine room and noted hourly. In the non-insulated compartments, air temperature is taken every two hours by means of a portable thermometer. Deck ventilators are continually trimmed—weather ventilators *away* from the wind, lee ones *into* the wind to form a continual air current.

Our New York terminal consists of two 608-foot piers, each 82 feet wide. The sheds built over the piers have continuous sliding doors, which facilitate spotting the hatches of the ship. The slip between the piers, while only 192 feet wide, gives the stevedores some space to work lighters alongside for discharging or loading.

To prevent the low temperature from affecting the tomatoes which usually lay at our terminal over night (sometimes longer) an extensive heating arrangement has been installed. On the south side of one pier, running some 200 feet in length, 25 feet in width and 15 feet high, a canvas tent has been constructed. It is a temporary adoption which can be removed in the summer. The sides, which are in sections, are easily raised to permit access either for the longshoremen or trucks which take delivery.

The blower pipe, some 18 inches in diameter with an outlet every 40 feet, runs from the blower along the ceiling to the end of the tent. Steam from the furnace, which is also used for heating the upstairs offices, passes through a series of coils. The outside air is sucked over the coils and is forced by a blower through the pipe into the tent. In this manner, while the temperature of the air of the dock may be in the neighborhood of zero, the temperature inside is easily kept at 50 to 55 degrees. This space can accommodate 16,000 lugs of tomatoes.

A similar heating arrangement is used on the bulkhead shed between our two piers. This space is 192 feet in length and 50 feet wide.

At the forward overall hatches, landing platforms are attached to the stringpiece to receive the slingloads. Mechanical belt conveyors are used for discharging at the forward and aft side-port entrances to the insulated compartments. At the three remaining side ports aft, and the two forward ones, lugs of tomatoes are hand-trucked out of the ship along the pier to the bulkhead compartment. Lugs of tomatoes stowed in 'tween decks are hoisted in specially constructed boxes, 8 feet long by 40 inches wide, to the deck on which they are hand-trucked out of the ship. The same type of box is used discharging lugs from the 'tween deck by way of the overall hatches to the dock where the lugs are placed on hand trucks and wheeled to the bulkhead shed at the street end of the pier.

In the event that a shipment consists of over 23,000 lugs of tomatoes, heated lighters are placed across the dock from the ship and used to store the lugs until delivery the following day.

Useful Hints on Cargo Handling

Portable Cranes

A Detroit terminal uses two steam locomotive cranes and two gasoline propelled cranes of the Caterpillar type for handling sugar, wood pulp and various other commodities. The crane capacities range from 10 to 35 tons. The booms range from 40 to 70 feet in length.

Steep Ramps

The Merchants & Miners Transportation Company at Boston have the steepest ramps of any terminal the author has seen. The trailers used for cargo handling are taken down these ramps by a tractor equipped with a coupler at both front and rear. The trailers are let down with the trailer bringing up the rear. In this manner the operation is performed smoothly.

Electric vs. Seam Winches

Ship operators and stevedores have often complained that electric winches are slower than steam operated winches. However, modern electric winches, with *series* motors and full automatic control, perform with thorough satisfaction and in addition have the usual advantages of electric winches of comparative silence and lower power cost.

Cargo-Handling Factors Important

The study of the design of a new ship or the reconditioning of a ship already built should be a thorough analytical study of all cargo-handling factors involved, if the ship is to operate with maximum economy.

Information should be collected from every possible source to avoid mistakes of design. Much can be learned from the experience of others.

Sea Water Damage

Hatches, manholes, ventilators, thermometer wells and other means of access to cargo space should be so designed as to make it almost impossible for sea water to reach the cargo without utter neglect or such extreme heavy weather that serious structural damage occurs to the ship. It is surprising to observe the number of instances of sea water damage reported, most of which occur when the ship has encountered no heavier weather than would be reasonably expected for the voyage and season.

Hatch Shelters

In Calcutta during the Southwest monsoons, long bamboo poles are used to support tarpaulins placed over the hatches during short squalls instead of covering hatches with the regular covers. This arrangement is not necessary when ships are fitted with steel hatch covers of the best design.

A dock superintendent reported as follows:

The S. S.—on voyage 12 arrived with only 1910 tons of cargo. Due to improper stowage in No. 1 hold, we will have to pay claims for approximately 1000 pounds of rice.

In the after end of the hold were two cars of paper. This was spread all over the square of the hold. Forward were five cars of rice, with 3188 bags tiered up straight, which toppled over en route damaging 28 bags. The contents seeped between the paper.

Because in the 28 bags there were five different grades of rice and the hatch was dirty, it was impossible to salvage any of the rice after the paper was discharged.

Adequate supervision at the loading port would have avoided the claims on the rice.

Economy in organization overhead costs which results in claim of this character is false economy.

Quick Dispatch of Motor Trucks

Facilities for quick dispatch of motor trucks are important in any terminal. Where freight cannot be handled at a platform, other arrangements may be provided. At the I. M. M. pier in New York the platform is lowered to a level with the tailboard of the truck, permitting the freight to be handled easily into the truck.

At other piers short lengths of gravity roller conveyors are a great aid. A more modern development is the pallet fork truck method, by which the freight is loaded to a pile of pallets, the lowered pallet being removed for piling on the dock by a fork truck.

The most effective method for loading a motor truck is to load the loaded pallets on to the truck and send the load in pallets to the consignee.

Equipment Charts

The author is completing equipment charts which will show in outline form the various types of equipment utilized for handling package freight and materials. The completed charts, which will be published in this section of *Marine Engineering and Shipping Review,* will show all the various types of equipment used for handling freight and materials in every kind of operation. First there will be a broad classification of equipment as follows:

Pallets and fork trucks	Mono-rails and telephers
Skids and low-lift power trucks	Chain and electric hoists
Skids and high-lift power trucks	Tiering machines
Skids and hand-lift trucks	Hand trucks
Tractors and trailers.	Hand trucks with racks
Crane trucks	Motor trucks
Power conveyors	Railroads
Gravity conveyors	Vessels
Chutes	

Note that railroads and vessels are included in materials handling equipment. A railroad operation extending 2000 miles is fundamentally only an enlarged tractor-trailer operation.

For short hauls in a warehouse, factory or on a terminal, skids and lift trucks, pallets and fork trucks, etc. are used; for long hauls tractors and trailers are used, alone, or in conjunction with skids, lift trucks and other equipment. Outside the warehouse, factory and terminal, motor trucks, railroads and vessels are used, the railroad and vessels exclusively for very long hauls—1000 to 10,000 miles. The same basic principles apply in all the above operations. Fundamentally, the difference is only in the length of the haul.

Marine Activities Along the Seaboard

Reports Requested on Navigation Aid Defects

The Commissioner of Lighthouses has requested that mariners plying the various coasts of the United States notify immediately the nearest Superintendent of Lighthouses of any defect or misplacement observed in an aid to navigation. Such co-operation, it is said, will assist materially in the prompt remedying of defects and in the effective maintenance of aids to navigation.

Post Office Department Approves Lykes Ships

The steamships *Edgehill* and *Colorado Springs* of the Lykes Steamship Lines on December 10 were reported to have passed government speed tests, qualifying them again for service on ocean mail routes originating in the Gulf. The vessels were withdrawn about six weeks ago and reconditioned. Subsequently they passed the 10-knot minimum requirement for service under Post Office Department contracts.

United Fruit Mail Contract Cancelled

The ocean mail contract held by the United Fruit Company for Route No. 41 was recently cancelled by agreement between the Post Office Department and the contractor, according to an announcement made by Postmaster General James A. Farley. The route is operated from New Orleans, via Havana and Cristobal, to Cartagena and Puerto Colombia. It was also announced, however, that the operation of this trade route will be continued, the company carrying mail at the American poundage rate. This contract is one of three held by the United Fruit Company, which were executed on March 21, 1930, to extend for a period of 10 years. The remaining two contracts are still in effect.

Complaint Entered Against Nelson Company

On December 23 the Department of Commerce, Shipping Board Bureau, announced that a formal complaint had been filed by the Gulf Intercoastal Conference Lines alleging that the Charles Nelson Company and its subsidiary, the Nelson Steamship Company, after repeated efforts to break into the intercoastal trade as common carriers, operating on a differential basis, are now seeking to accomplish their purpose as contract carriers without filing rates as required by the Intercoastal Shipping Act of 1933.

San Francisco Applies for Foreign Trade Zone

According to a recent announcement by Secretary of Commerce Daniel C. Roper, chairman of the Foreign Trade Zone Board, the Board of State Harbor Commissioners of San Francisco has applied for a grant to establish a foreign trade zone in that port. The zone would embrace the two outer transit sheds on Pier 45, together with the adjacent uncovered area of the pier and portions of the adjacent slips sufficient to permit the berthing of ships. This property is owned by the State of California and is under the jurisdiction of the Board of State Harbor Commissioners. After preliminary analysis and reference of the matter to the Secretary of War and the Secretary of the Treasury, members of the Foreign Trade Zone Board, the Secretary of Commerce will call a public hearing at San Francisco for the purpose of obtaining facts useful in deciding the matter.

Shipping Board Studies Free Storage for Imports

A. L. Lansdale, examiner for the Shipping Board Bureau of the Department of Commerce, conducted hearings in December at New York on complaints about the abuse of free storage privileges for imported goods at New York steamship piers. Interests in other ports had charged that a considerable volume of business had been diverted to that city by such free storage. The objecting ports, however, in most cases do not have any dockage charges themselves.

Shipping men who testified at these hearings were generally in favor of reasonable charges for storage service, provided they applied to all shippers in all ports. Some sentiment was expressed, however, for exceptions in favor of a few commodities of special character such as rubber, tin, tapioca flour, peat moss and cocoa beans.

The Shipping Board Bureau will undoubtedly issue an order, after due consideration of the evidence, that will fix a reasonable limit on free time at piers.

Black Diamond Resigns from Ship Association

The Black Diamond Line's withdrawal from the American Steamship Owners' Association early in December, 1935, in protest over the latter's failure to agree on a definite ship subsidy program for submission to the next Congress, is expected to be the forerunner of action by American lines which operate solely in foreign trades banding together to work for the enactment of subsidy legislation. It is reported that several of these lines already have held meetings to consider the steps they will take as a separate group to fight for adequate aids which in their opinion should be liberal enough to enable them to compete successfully with foreign lines.

The position of the American Steamship Owners' Association is that the proposed Federal aids should be treated as a benefit for all American lines, irrespective of the definite classifications of foreign trade, semi-protected trade, and intercoastal trade. It is felt that in the interests of presenting unanimity on shipping problems both before Congress and the government agencies administering merchant marine affairs specific trades cannot be treated independently.

Transatlantic Conference May Regrade Passenger Ships

At about the time this issue goes to press the principals of the Transatlantic Passenger Conference are expected to hold a special meeting in Paris to consider the movement now under way to have all trans-Atlantic liners regraded into a single class and to fix fares on the basis of the age, size and speed of each ship.

This move follows the announcement some weeks ago of Sir Percy Bates, chairman of the *Cunard-White Star, Ltd.,* when he applied to the conference to grade the *Queen Mary* as a cabin ship. His request was granted and fares were fixed slightly under those of the French liner *Normandie.*

Some time later, it was learned that the French line had applied to the conference to regrade the *Normandie* as a cabin ship and to quote the same fares as those fixed for the *Queen Mary.*

The movement to have all Atlantic liners regraded into one class is believed to have grown out of the *Manhattan* and *Washington's* continued popularity.

Rates Approved on Citrus Fruits

The Interstate Commerce Commission over the protests of steamship lines recently approved the application of railroads to institute the so-called sailing day plan, by which rates on citrus fruits in carloads from points in Florida to New York, Philadelphia, Baltimore, and New England may be made without observing the long and short haul provision of Section 4 of the Interstate Commerce Act. The Commission's order authorizes rail carriers to establish, until July 31, 1936, rates which are the same as those of the truck-water routes.

New Zealand Would Curb American Ships

Australian and New Zealand interests are seeking the enactment of legislation to restrict the trade between the two dominions to British-flag shipping, as a curb against the growing competition of the successful American-flag vessels operated by the Matson Line. It is maintained that Australian-New Zealand trade should be considered as coastwise and should therefore be restricted to British vessels on the same basis that the coastwise laws of the United States prohibit British shipping from engaging in the passenger and freight trade between the United States and Hawaii.

Supervising Inspectors to Meet

Joseph B. Weaver, director of the Bureau of Navigation and Steamboat Inspection of the Department of Commerce, announces that the Board of Supervising Inspectors will hold its annual hearings in Washington beginning on January 15.

According to Mr. Weaver the Board will probably be organized and committee appointments be completed during the five days immediately following that date. Among the matters to be discussed are life preservers, fire indicating and alarms systems, the various elements used in fire extinguishers, boilers, loud speakers, and life-saving equipment generally.

The supervising inspectors on the board are: William Fisher, First District, San Francisco; George Fried, Second District, New York; Eugene Carlson, Third District, Norfolk; Harry Layfield, Fourth District, St. Louis; Oscar G. Haines, Fifth District, Boston; Edward Maurer, Sixth District, Louisville; Francis W. J. Buchner, Seventh District, Pittsburgh; Alvin A. Morrison, Great Lakes District, Detroit; Cecil N. Bean, Tenth District, New Orleans; Jesse E. Murry, Eleventh District, Seattle.

Shipping Board Studies Dollar Line Operation

After conferences between R. Stanley Dollar, president of the Dollar Lines, and Shipping Board Bureau officials early in December concerning overdue principal payments on ship sales and construction loan mortgage notes, L. D. Staver, general comptroller of the Shipping Board Bureau, was assigned to the San Francisco offices of the Dollar Lines for the purpose of assisting in the rehabilitation of the company's business. According to the latest statement on past due securities, the Dollar companies have overdue principal payments totaling $2,820,101 on outstanding obligations, aggregating $15,000,000. All interest payments on ship sales and construction loans have been made up to date. Officials of the line have pointed out that the financial structure is entirely sound and that the essential character of the Dollar services would continue to justify Federal aid under the displacement of present mail contracts by proposed new shipping legislation. The conference developed the fact that the Government intends to give the Dollar lines strong support in view of its front rank in the merchant marine.

Marine Labor Conference Adjourns

The preparatory Maritime Conference called by the International Labor Organization was concluded at Geneva, Switzerland, on December 6 with the prospects better than at its beginning for a final conference next November to adopt a convention on the manning of ships and the hours worked. The convention is expected to provide for a system of three watches of eight hours each aboard ships. It was on this point that the American delegation pressed the hardest but a difficult fight apparently looms in the final conference, particularly by British shipowners and their government. This preliminary conference prepared reports summarizing the positions taken during the sessions on the questions of hours and manning and on paid vacations. Dr. Robert W. Bruere, the United States convention delegate, announced that Washington had authorized him to support the three-watch system, without overtime after the delegates of American shipowners and seamen—Samuel Aitken and Andrew Furuseth, respectively—had come out for this system, which is in advance of the American Seamen's Act in that it also covers deck crews.

Panama Canal Traffic Decreases

According to reports issued by the War Department, traffic through the Panama Canal for the month of November, 1935, decreased slightly. A total of 418 commercial vessels traversed the canal in November as compared with 441 vessels in October, and 469 commercial vessels in November, 1934.

In his annual report on the waterway toll, J. L. Schley, governor of the Panama Canal, urged that legislation be enacted to provide a single unit system for levying collections. A decrease in tolls has been alleged because of "manipulation" of tonnage computations of ships using the waterway. The question has occupied the attention of Congress and has been repeatedlv recommended by the canal administration, but never enacted. By the proposal the present dual system of measurement would be eliminated by which tolls are based on one tonnage, while certain limiting factors are based on a different and smaller tonnage which has become subject to manipulation.

Up and Down the Great Lakes

Ore Movement Exceeds Last Year

The iron ore shipment for the season of 1935 reached a total of 28,362,368 long tons, which is an increase of 6,112,768 long tons over the season of 1934.

Shipments from upper lake ports during the month of November were 1,557,494 long tons, as compared with 484,191 long tons for the month of November, 1934, an increase of 221.67 percent. The increases for the whole season of 1935 over the year before was 27.47 percent.

Shipments of ore by rail from Lake Erie ports to furnaces during the month of November amounted to 1,021,818 long tons, making a total for the season, up to December 1, of 14,012,447 long tons. This compares very favorably with similar shipments, for the same period, in 1934, of 11,098,768 long tons. Balance of ore on dock at Lake Erie ports December 1 was 5,313,265 long tons as compared with 5,348,555 long tons on December 1, 1934.

Repairs to Freighter

The M. A. Hanna Company, Cleveland, expects to carry out major repairs to the bulk freighter *Louis W. Hill.* It is planned to renew the tank top and the lower strakes of the side tank bulkheads throughout the cargo spaces. It is understood that the tank top will be of customary flat plate, riveted construction. The work will be carried out at the yard of the Toledo Shipbuilding Company, Inc., Toledo, O., during the winter.

Built by The American Ship Building Company at its Lorain, O., yard, in 1917, the *Hill* is a typical 10,000-ton capacity Great Lakes bulk freighter. Her dimensions are: Length overall, 547 feet; length on keel, 525 feet; beam, 58 feet; and depth, 31 feet. Her gross tonnage is 7038, and her carrying capacity on a draft of 20 feet is about 10,700 long tons.

The M. A. Hanna Company operates nine additional bulk freighters, the smallest of which has a carrying capacity, on a 20-foot draft, of 9500 long tons. George H. Warner is the operating manager of the fleet.

Season of Navigation Ends

December 15 can usually be counted upon as the extreme limit of navigation, though major activities end a month earlier.

The steamer *Backbay* of Sullivan & Company, Chicago, upbound from Buffalo, N. Y., for South Chicago, Ill., passed through the Straits of Mackinac on December 17 as the last vessel of the season.

Downbound the steamer *Superior,* from Fort William to Midland, Ont., with a load of storage grain, passed through the locks at Sault Ste. Marie on December 12, the last vessel scheduled for the season, though the locks were not officially closed until December 15.

The last of the vessels carrying grain to Buffalo were the *George F. Rand* and *W. C. Warren* clearing at the head of the lakes on December 3 with the sixty-eighth and sixty-ninth cargoes and the *J. P. Walsh* clearing December 4 with the seventieth grain cargo dispatched to this port during the season.

The ore season on Lake Superior was closed by the steamer *Albert E. Heekin* of the M. A. Hanna Company in taking on a load of ore at Duluth on November 26. The ore season at Marquette and Escanaba also closed later in November.

The Welland Ship canal was officially closed on December 15.

Installing Watertube Boilers

Work is now under way at the Lorain, O., yard of The American Ship Building Company, in reboilering the bulk freighters *Elbert H. Gary, G. G. Crawford* and *Geo. W. Perkins* of the Pittsburgh Steamship Company, Cleveland. The vessels are to be ready about April 1, before the opening of navigation.

The two Scotch type of boilers in each vessel are being removed and will be replaced by two standard cross-drum Babcock & Wilcox marine watertube boilers, having a working pressure of 250 pounds per square inch. The total combined heating surface of the two new boilers for the *Gary* and the *Perkins* will be about 7300 square feet for each ship and no superheaters are to be installed.

The *Crawford* is to have a superheater of about 290 square feet heating surface operated at 50 degrees F. superheat. The total combined heating surface of the two boilers for the *Crawford* will be about 7000 square feet.

November Lake Levels

The United States Lake Survey reports the following monthly mean stages of the Great Lakes for the month of November, 1935:

Lakes	Feet Above Mean Sea Level
Superior	602.76
Michigan-Huron	578.13
St. Clair	573.22
Erie	570.05
Ontario	243.12

Lake Superior was 0.09 foot lower than in October and it was 0.16 foot below the November stage of a year ago, 0.31 foot above the average stage of November of the last ten years.

Lakes Michigan-Huron were 0.03 foot lower than in October and they were 0.56 foot above the November stage of a year ago, 0.65 foot below the average stage of November of the last ten years, 3.05 feet below the high stage of November, 1917, and 0.56 foot above the low stage of November, 1934.

Lake Erie was 0.07 foot lower than in October and it was 0.51 foot above the November stage of a year ago, 0.98 foot below the average stage of November of the last ten years, 2.93 feet below the high stage of November, 1917, and 0.51 foot above the low stage of November, 1934. Based on past records the monthly mean level for December is likely to be about 570 and not less than 569.6 feet above mean sea level.

Lake Ontario was 0.17 foot lower than in October and it was 0.44 foot above the November stage of a year ago, 1.58 feet below the average stage of November of the last ten years and 3.57 feet below the high stage of November, 1917.

Work in Lake Shipyards

Though there is no new shipbuilding in sight at the present time, it is anticipated that the shipyards of the Great Lakes will be fairly busy throughout the winter months. In addition to the customary repairs and overhauling, several major repair jobs are under way, including the replacement of 25 shell plates to the steamer *Ace* at the Buffalo plant of The American Ship Building Company, and the replacement of 27 shell plates to the tanker *Martha E. Allen* of the Lake Tankers Corporation at the Lorain, O., plant of The American Ship Building Company.

The allocation of load lines to vessels on the Great Lakes will also, it is expected, call for considerable work not ordinarily required; especially will this be true of dry docking. No load lines, it is understood, will be assigned to any vessel which has not been in dry dock within the last five years, which is the interval required for the usual inspection for classification. Since many vessels are not classed, it is variously estimated that from 200 to 300 vessels will need to be dry docked for inspection before assignment of load lines.

Freight Traffic Through Canals

Eastbound freight through the United States and Canadian canals at Sault Ste. Marie during November totaled 2,871,092 tons, an increase of 1,147,227 tons over the month of November, 1934. Iron ore increased from 586,133 tons to 1,572,375 tons. Wheat decreased from 27,636,469 bushels to 26,953,564 bushels, and other grains increased from 6,848,267 bushels to 11,262,342 bushels. Westbound freight increased from 903,072 tons to 1,216,311 tons.

With a heavy movement of wheat, gasoline, iron and steel, wood pulp and iron ore, total freight through the Welland ship canal increased from 1,253,412 tons in November, 1934, to 1,313,023 tons during November, 1935. Barley, corn, oats, rye, soft coal, coke and pulpwood, all decreased substantially from the amount moved in November, 1934.

Total freight through the St. Lawrence canals for the month of November, 1934, amounted to 865,469 tons as compared with 883,598 tons during November, 1934. The larger increases were in beans, 27,652 tons; sugar, 16,477 tons; paper, 10,996 tons; wood pulp, 48,252 tons; and iron ore, 18,775 tons.

Coal Movement

The bituminous coal shipments via lake vessels from Lake Erie ports during the season of 1935 will compare quite closely with the movement in 1934 but will probably be about 150,000 tons less.

From the beginning of the season of 1935 up to 7 a. m. December 16, 34,680,221 short tons of cargo and 1,105,-995 short tons of bunkers, making a total of 35,786,216 short tons of bituminous coal, were moved. This is a decrease of 113,014 short tons from the total tonnage moved last year for the same period, which amounted to 35,899,230 short tons, 34,800,744 tons of cargo and 1,098,486 tons of bunkers.

The total movement of bituminous coal for the season of 1935 up to December 16, however, showed an increase of 3,551,473 short tons over the tonnage moved during the same period in 1933 and 10,694,893 short tons over the same period in 1932. Cargo coal moved during the same period in 1933 amounted to 31,255,689 short tons and bunkers, 979,054 short tons, totaling 32,234,743 tons. In the same period of 1932, cargo, bunkers, and total bituminous coal shipments were 24,482,871 short tons, 608,452 short tons and 25,091,323 tons.

Average shipments of bituminous coal each week for the four weeks ending 7 a.m. December 16 amounted to 527,150 short tons of cargo and 14,036 short tons of bunkers, or a total of 541,186 short tons.

Anthracite coal shipments on the lakes for the season of 1935 up to December 1 amounted to 499,009 long tons. This is a decrease of 42,967 tons for the same period in 1934. It is, however, a substantial increase over the same period in 1933, when the movement was 379,685 long tons. During the same period in 1932 the movement of anthracite coal was only 262,433 long tons.

Canadian Grain Shipments

Lake shipments of grain from Fort William and Port Arthur, Ont., during the entire season of navigation, 1935, exceeded those for the season of 1934 in wheat, flaxseed, rye, barley malt, mixed feed oats groats and screenings, and were less for oats and barley.

The comparative figures for the various grains showing increases for the season of 1935 over 1934, respectively, are as follows: wheat, 166,384,566 bushels and 153,931,619 bushels; flaxseed, 482,832 bushels and 328,-800 bushels; rye, 729,276 bushels and 689,283 bushels; barley malt, 14,083,680 pounds and 10,445,690 pounds; mixed feed oats groats, 750 tons and 530 tons; and screenings, 51,919 tons and 47,626 tons.

Comparative figures for grains showing decreases during 1935 as compared with 1934 are as follows: oats, 12,097,547 bushels and 13,503,433 bushels; and barley, 7,643,773 bushels and 13,332,792 bushels. All told, therefore, the season of 1935 showed some improvement over 1934. Of the total shipment of wheat, 91,887,238 bushels were shipped to Canadian ports and 74,497,328 bushels to United States ports.

From November 15 to the close of navigation, December 10, inclusive, grain was shipped from Fort William and Port Arthur, Ont., via lake vessels, as follows: wheat to Canadian lower lake ports, 8,501,644 bushels; to Montreal, 505,312 bushels; to Buffalo, 10,368,587 bushels; and to United States ports other than Buffalo, 813,-245 bushels. This makes a total of 20,188,788 bushels of wheat shipped during this period.

Oats moved during the same period from the same ports in the following quantities: to Canadian lower lake ports, 2,483,525 bushels; and to Montreal, 18,823 bushels; making a total of 2,502,348 bushels of oats shipped.

The movement of barley from the same ports total 509,221 bushels to Canadian lower lake ports and 84,474 bushels to Montreal. During the same period, 124,780 bushels of flaxseed moved to Canadian lower lake ports. No rye was shipped. A total of 1,080,450 pounds of barley malt was shipped to Montreal.

During the same period screenings moved in the following quantities: 1563 tons to Canadian lower lake ports; 4595 tons to Buffalo, and 4077 tons to United States ports other than Buffalo.

The total in all kinds of grain shipped via lake vessels from Fort William and Port Arthur from November 15 to the close of navigation, December 10, both inclusive was 23,505,620 bushels and 1,080,450 pounds of barley malt and 10,235 tons of screenings.

Late Decisions in Maritime Law

Legal Tips for Shipowners and Officers

Compiled by Harry Bowne Skillman
Attorney at Law

Tax assessment, made against a partnership which owned a schooner, but which included no record identification of the specific schooner meant to be assessed, according to the case of Commercial Township, Cumberland County, N. J., v. Stowman, 79 F. (2d) 129, and no tax lien was imposed in admiralty upon a specific schooner belonging to the partnership.

* * *

Tug which was pushing a barge which collided with a ferryboat was liable for damages caused by collision, it was decided in the case of *America,* 11 Fed. Supp. 133, where the vessels were approaching each other at right angles or obliquely so that the situation was one of crossing courses, and the ferryboat was the privileged vessel while the tug was the burdened vessel and bound to keep out of the way of the ferryboat, and the tug did not change her course or speed and did not sound any signal until almost the time of impact.

* * *

Tug, with floats in tow, which, although it was the burdened vessel as respects a steamer with which it was on a crossing course, attempted to cross the steamer's bow and to pass starboard to starboard, and notwithstanding it had received the assent of the steamer, assumed the risk involved in the choice, rendering it liable for damages caused by the collision resulting despite such co-operation as the steamer was able to give, since the steamer by giving consent to the maneuver merely assumed the duty to co-operate.—*Lexington,* 79 F. (2d) 252.

* * *

In suit for injuries by a steamship passenger, injured when getting out of an upper berth, an instruction to the jury that the steamship company owed the passenger the highest degree of care, prudence, and foresight in the operation of its vessel, consistent with proper management thereof, was proper, it was declared in the case of Pacific Steamship Company v. Holt 77 F. (2d) 192; and the contention that the degree of care imposed upon the company was that commonly known and referred to as ordinary care or reasonable care, and that the degree of care imposed by the instruction to the jury was applicable to a common carrier by water only with reference to the hull and machinery of the vessel, was rejected, the court saying that with respect to all special perils of transportation, and all the instrumentalities of transportation, and their proper management, control, and fitness, the strict rule of the highest degree of care obtains.

* * *

Rule of the Secretary of War providing that, except in great emergency, a vessel should not be anchored in Bedford Outer Harbor or Vineyard or Nantucket Sound outside the anchorage area, was held valid (in the case of *City of Chattanooga,* 79 F. (2d) 23, and it was not invalidated by the alleged failure of the Commissioner of Lighthouses to provide buoys or other suitable marks for marking anchorage grounds. It was held, further, that a vessel may not at her pleasure select for anchorage any part of the fairway which other vessels are not likely to use, where there are designated grounds set apart for anchorage, and where the fault of a tug, in anchoring with barges in the fairway instead of the anchorage grounds in Vineyard Sound, contributed to a collision in a fog between a steamship and one of the barges, damages must be equally divided and could not be apportioned according to the degree of fault, though the fault of the steamship was so gross that upon any just allocation she ought to bear substantially all the loss.

* * *

Subcontractor, who, in violation of government permit and the main contract, laid a power cable for a draw bridge above, instead of below, the river bottom, was liable for damages caused to a tug when her propeller picked up the cable, though the work had been completed some five months before the accident. The City of New York, aware of, but not having authorized, the unlawful installation, was only jointly liable, it was decided in the case of *Wonder,* 79 F. (2d) 312, and on being sued in damages by the tug owner, was entitled to contribution from such subcontractor.

* * *

If the barge or master has received express assurance that the berth is fair and relies upon it, he is not at fault. If he receives that assurance but does not rely upon it and undertakes to sound for himself, both are at fault and damages are divided. If he gets no express assurance, he must sound, and again the damages are divided. Relying upon this rule, it was held in Cities Service Transportation Company v. Gulf Refining Company, 79 F. (2d) 521, which was a suit for breach of a charter party in which the charterer agreed that a steamer should load and discharge at a dock, or alongside lighters, which should be indicated by the charterers and where the steamer could lie always afloat, that the masters who relied upon the word of the port captain who pointed out a place where the steamer should lie to load, without sounding, was not at fault for the steamer's taking a strand, injuries resulting.

* * *

Friend who, upon invitation of a passenger's daughter, had gone on board a transatlantic ship to say goodbye to such passenger, and, while walking toward the passenger's stateroom, caught her foot upon the top of a companionway, assumed to have been negligently left out of repair, was a business visitor, not a licensee, and hence the shipowner was liable. "The tradition still to some extent endures," said the court in the case of McCann v. Anchor Line, 79 F. (2d) 339, "that such a trip (transatlantic) is an occasion of some consequence; passengers like to have their friends see them off, and have come so far to expect it as part of the prerequisites of the trip that they would resent its denial in a way that would be serious to the line that undertook to deny it. It seems to us that for this reason, leave to visitors to go aboard is in the interest of the shipowner; it is a customary appurtenance of the passengers' privileges which he cannot safely refuse, which indeed is not extravagant to consider as one of the inducements that he holds out to them, and for which he is paid."

* * *

Though a vessel owner owes the duty to a stevedore employed by a stevedore independent contracting company of providing a safe place in which to work and to exercise ordinary care to keep the premises fairly safe and secure against danger, such owner is not liable, it was said in Panama Mail Steamship Company v. Davis, 79 F. (2d) 430, for injuries from hydrocyanidic poisoning sustained by a stevedore who was ordered to begin loading after a government expert had fumigated a vessel and turned it over to the owner's officers after determination that gas had entirely escaped, since the owner exercised reasonable care in relying on work and word of the government's expert that the ship was safe for loading.

Marine Business Statistics Condensed

Record of Traffic in Foreign Trade at Principal American Ports

New York

Month	Entrances No. ships	Entrances Net tonnage	Clearances No. ships	Clearances Net tonnage
November, 1935	408	1,815,698	426	1,873,222
October	423	2,063,839	455	2,181,407
September	454	2,296,885	429	2,181,727
August	485	2,410,727	509	2,547,739
July	507	3,261,057	510	2,308,106
June	446	2,123,325	457	2,169,623
May	338	2,059,686	476	2,194,913
April	460	2,823,172	460	2,297,895
March	424	2,151,900	454	2,240,198
February	368	1,846,603	384	1,813,244
January	412	2,069,982	440	2,131,740

Boston

Month	Entrances No. ships	Entrances Net tonnage	Clearances No. ships	Clearances Net tonnage
November, 1935	120	396,894	121	404,069
October	144	517,770	142	517,026
September	163	595,139	162	592,819
August	201	680,434	198	656,900
July	181	554,887	178	561,651
June	153	407,049	124	344,556
May	157	503,572	160	503,808
April	122	429,195	124	457,417
March	124	447,541	126	446,456
February	104	385,520	107	394,441
January	116	445,990	114	427,402

Philadelphia
(Including Chester, Wilmington and the whole Philadelphia port district)

Month	Entrances No. ships	Entrances Net tonnage	Clearances No. ships	Clearances Net tonnage
November, 1935	125	411,236	136	446,165
October	131	412,776	122	382,967
September	127	403,533	124	391,491
August	150	493,296	153	500,731
July	141	444,659	141	445,471
June	143	448,611	140	474,146
May	149	455,196	157	494,182
April	158	473,766	148	464,016
March	144	453,643	140	449,186
February	102	312,963	119	384,859
January	105	336,019	116	376,343

Baltimore

Month	Entrances No. ships	Entrances Net tonnage	Clearances No. ships	Clearances Net tonnage
November, 1935	91	286,463	94	292,227
October	98	308,811	106	326,839
September	99	296,722	108	319,145
August	114	335,421	115	337,194
July	115	331,909	126	358,513
June	115	354,647	104	318,929
May	119	356,505	116	347,292
April	104	316,476	104	331,839
March	100	293,568	107	325,453
February	85	267,417	92	291,094
January	86	276,468	88	286,810

Portland, Me.

Month	Entrances No. ships	Entrances Net tonnage	Clearances No. ships	Clearances Net tonnage
November, 1935	13	33,620	15	40,044
October	21	45,636	22	43,791
September	19	32,509	17	31,913
August	25	36,147	23	37,308
July	18	25,596	17	22,728
June	20	31,292	20	33,342
May	15	19,747	14	21,319
April	11	27,747	11	23,129
March	10	24,475	9	21,745
February	11	23,834	12	27,693
January	12	31,676	10	25,804

Providence

Month	Entrances No. ships	Entrances Net tonnage	Clearances No. ships	Clearances Net tonnage
November, 1935	5	12,999	4	9,802
October	4	9,964	4	10,082
September	4	599	4	4,651
August	3	6,253	5	7,241
July	13	31,908	9	18,779
June	6	14,226	5	10,858
May	5	13,206	6	20,240
April	6	20,333	3	6,596
March	6	20,792	4	14,033
February	5	22,152	6	25,619
January	4	12,463	7	20,586

New Orleans

Month	Entrances No. ships	Entrances Net tonnage	Clearances No. ships	Clearances Net tonnage
November, 1935	92	214,627	97	229,636
October	180	455,840	175	447,350
September	171	437,947	179	465,264
August	200	500,771	194	480,056
July	197	542,700	183	476,305
June	184	502,937	191	499,413
May	183	482,299	195	484,065
April	188	504,227	173	465,173
March	183	474,712	173	425,843
February	166	457,420	165	439,990
January	166	457,267	166	435,232

Norfolk and Newport News

Month	Entrances No. ships	Entrances Net tonnage	Clearances No. ships	Clearances Net tonnage
November, 1935	128	407,956	134	423,287
October	130	408,185	131	405,469
September	108	343,203	105	336,335
August	139	408,964	140	418,704
July	122	356,677	121	345,352
June	132	374,592	130	361,401
May	131	405,144	126	375,243
April	127	388,429	122	380,770
March	122	374,447	127	391,523
February	109	330,108	115	335,404
January	138	429,759	136	402,944

Jacksonville

Month	Entrances No. ships	Entrances Net tonnage	Clearances No. ships	Clearances Net tonnage
November, 1935	43	115,582	38	103,764
October	40	107,388	40	98,550
September	44	124,853	38	101,097
August	37	98,794	34	89,380
July	43	116,334	35	96,912
June	27	67,170	34	85,364
May	27	61,256	27	66,011
April	34	79,609	34	80,808
March	31	63,749	29	62,261
February	25	61,714	26	66,594
January	18	49,375	24	70,832

Mobile

Month	Entrances No. ships	Entrances Net tonnage	Clearances No. ships	Clearances Net tonnage
November, 1935	49	130,642	46	132,889
October	46	127,433	58	160,496
September	46	122,604	38	99,376
August	46	121,935	51	133,377
July	46	118,084	46	104,915
June	42	106,832	44	123,966
May	51	135,639	43	111,836
April	40	112,784	39	106,734
March	45	109,978	46	112,995
February	41	102,099	36	91,813
January	46	129,386	48	135,215

Key West

Month	Entrances No. ships	Entrances Net tonnage	Clearances No. ships	Clearances Net tonnage
November, 1935	23	29,880	22	28,392
October	28	46,010	29	47,350
September	28	44,926	30	47,618
August	26	33,981	24	35,100
July	37	43,037	35	42,948
June	36	41,569	37	48,681
May	49	59,990	49	57,044
April	52	39,491	38	46,737
March	31	37,869	30	34,093
February	32	34,322	32	37,498
January	32	37,232	34	37,563

Charleston

Month	Entrances No. ships	Entrances Net tonnage	Clearances No. ships	Clearances Net tonnage
November, 1935	21	51,386	19	49,932
October	22	55,180	23	57,419
August	13	31,026	11	27,263
July	13	35,019	6	21,658
June	20	59,452	12	35,629
May	16	39,756	14	34,209
April	20	48,434	8	20,276
March	15	33,456	8	23,807
February	16	42,673	16	39,011
January	20	54,969	13	34,125

Los Angeles

Month	Entrances No. ships	Entrances Net tonnage	Clearances No. ships	Clearances Net tonnage
November, 1935	198	755,073	193	753,879
October	214	790,644	206	773,466
September	214	770,136	187	736,969
August	255	876,566	230	866,383
July	233	856,769	233	815,544
June	255	837,279	201	812,904
May	265	908,224	294	908,788
April	214	807,692	209	824,533
March	248	978,707	232	932,392
February	203	782,886	196	788,189
January	199	773,531	196	771,662

San Francisco

Month	Entrances No. ships	Entrances Net tonnage	Clearances No. ships	Clearances Net tonnage
November, 1935	128	540,042	157	672,795
October	133	567,804	157	669,561
September	144	570,694	119	538,866
August	160	701,896	155	680,999
July	156	692,261	163	711,768
June	153	676,557	164	703,968
May	165	734,666	168	742,901
April	161	686,156	176	707,749
March	157	684,905	163	688,194
February	100	609,987	164	669,680
January	142	638,652	162	672,411

Houston

Month	Entrances No. ships	Entrances Net tonnage	Clearances No. ships	Clearances Net tonnage
November, 1935	93	333,340	93	335,930
October	69	249,265	65	224,740
September	82	307,039	79	233,469
August	73	281,432	68	248,810
July	86	384,617	82	296,738
June	78	301,106	74	281,068
May	78	283,922	74	258,121
April	64	234,916	60	210,474
March	64	232,928	65	218,169
February	60	210,483	53	175,387
January	71	232,409	68	217,910

Galveston

Month	Entrances No. ships	Entrances Net tonnage	Clearances No. ships	Clearances Net tonnage
November, 1935	80	239,043	84	259,769
October	63	183,726	58	152,003
September	73	211,961	71	206,375
August	53	151,762	53	149,692
July	67	195,763	66	190,599
June	82	227,942	82	238,144
May	78	221,243	77	208,359
April	76	208,534	75	208,775
March	72	197,624	70	188,227
February	66	195,014	66	188,027
January	60	177,183	62	178,500

Seattle

Month	Entrances No. ships	Entrances Net tonnage	Clearances No. ships	Clearances Net tonnage
November, 1935	40	165,599	41	169,172
October	56	235,214	60	242,690
September	41	181,767	44	190,985
August	35	152,315	40	178,621
July	34	157,607	31	139,816
June	34	154,707	36	162,266
May	35	148,801	39	163,880
April	47	200,067	50	206,729
March	42	182,384	47	202,641
February	48	211,876	47	203,927
January	56	212,386	63	249,805

Portland, Ore.

Month	Entrances No. ships	Entrances Net tonnage	Clearances No. ships	Clearances Net tonnage
November, 1935	39	140,859	43	157,723
October	47	173,242	49	176,159
September	35	126,881	40	142,452
August	25	96,598	28	107,857
July	31	120,912	33	128,518
June	26	97,369	25	92,030
May	32	121,173	31	116,738
April	29	105,011	32	115,386
March	37	143,915	37	144,379
February	41	160,445	45	175,091
January	45	157,562	45	158,661

Exide Marine Batteries for 1936

For 1936 Exide offers a full line of storage batteries, especially designed and ruggedly built to meet the strenuous requirements of marine service. These batteries are available in 6, 12, 32 and 115-volt sizes.

The new Exide 1936 line divides itself into two types of high quality, heavy duty batteries. The first type is the Exide-Ironclad marine battery—32 and 115 volt. The second type is the Exide Marine (flat plate) battery, which is available in all sizes of 6 to 115 volts.

In designing and constructing the 1936 line of marine batteries, whether flat plate or Ironclad types, Exide engineers kept foremost in mind the particular and essential requirements which marine service imposes upon storage batteries. As a result, the current line of Exide marine batteries assures boat owners a high degree of dependability; the ability to deliver full rated capacities under the most strenuous circumstances; and the ability to give the maximum of dependable service under all conditions with the absolute minimum of attention.

New Exide Ironclad 32-volt marine battery

The exceptionally long life and high quality of Exide-Ironclad heavy duty marine batteries offers unusual value. These batteries have a remarkable record for dependability, durability and economy, which is especially desirable when used on yachts, commercial fishing vessels, tugboats, work boats, freighters and ocean liners—steam or Diesel-driven.

The Exide-Ironclad marine battery employs the same construction, and embodies the same efficient electrical characteristics as do the batteries used aboard the majority of United States submarines to propel, light, heat and ventilate these giant underseas craft while running submerged.

The unusual performance of Exide-Ironclad marine batteries rests entirely upon the soundness of their design, thoroughness of their construction and high quality of the materials with which they are built. The secret of their unusually long life is the unique construction of the Exide-Ironclad positive plate and the Mipor separation of these plates.

The unique construction of slotted rubber tubes of the Ironclad positive plate, retains the active material of the plate and at the same time permits free access of the electrolyte, much like a net retains the fish but lets the sea run through it. Furthermore, in dealing with internal strains engineers recognize the fact that cylindrical or tubular construction provides maximum structural strength.

Mipor separators also help to increase the life of the Exide-Ironclad battery. As is well known, the temperatures in an engine room are rarely ideal. They run to extremes—usually on the hot end. Frequently, the battery must be located near the engine and operate under conditions of excessive heat and inadequate ventilation. Exide-Ironclad marine batteries have long rendered satisfactory service under these conditions.

Exide Mipor separators are immune to the heat encountered in a battery. Exide Mipor is vulcanized rubber, permeated with pores so numerous as to permit free diffusion of the electrolyte, and of such microscopic size as to form a barrier to the smallest particles of active material. Exide Mipor is flexible and resilient, unaffected by heat and electrolyte alike. They will not crack or deteriorate under operating conditions during the entire long life of an Exide-Ironclad battery.

The larger batteries are assembled in units of 4 cells each and will be stocked for prompt shipment and can be quickly installed as 32 or 115-volt batteries. Exide batteries are products of the Electric Storage Battery Company, Philadelphia.

Load Lines for Lake Vessels

As a preliminary step in the formulation of rules and regulations for the establishment of load lines for vessels on the Great Lakes in accordance with the act approved August 27, 1935, shipowners and operators attended a public hearing, called by Joseph B. Weaver, director of the Bureau of Navigation and Steamboat Inspection, at the Federal building, Cleveland, on December 3.

An advisory committee to aid in the preparation of the rules had been appointed by Mr. Weaver prior to the meeting, as follows:

L. N. Prior, head of the load line division of the Bureau of Navigation and Steamboat Inspection, Washington, D. C.; L. C. Sabin, vice-president, Lake Carriers' Association, Cleveland; D. W. Arnott, chief surveyor, American Bureau of Shipping, New York; Dwight True, naval architect, Great Lakes Engineering Works, Detroit; and Captain R. W. England, operating manager, Interstate Steamship Company, Cleveland; with Mr. J. B. Weaver, director of the Bureau of Navigation and Steamboat Inspection, as chairman. L. C. Sabin was elected vice-chairman and L. N. Prior, secretary.

After some discussion, it was decided that this committee should be enlarged to include representatives of other than the bulk trades, such as passenger and package freight lines, car ferries, etc., and the following were added to the committee: W. H. Muir, Detroit & Cleveland Navigation Company, Cleveland; C. F. Bielman, Jr., vice-president, Tashmoo Transit Company, Detroit; L. H. Kent, fleet engineer, Pere Marquette Railway Company, Ludington, Mich.; and F. W. Ohlemacher, Kelley Island Line and Transport Company, Sandusky, Ohio.

A rough draft of proposed rules and regulations, based mainly on those in effect for vessels in foreign service, prepared by Mr. Prior, was read to the meeting and discussed as to practicability for application on the Great Lakes.

Though the American Bureau of Shipping is specifically designated in the act as an agency for the Department of Commerce in carrying out the conditions of the act, it was made clear that other qualified agencies may be designated for this purpose by the Secretary of Commerce at the request of the shipowner.

Questions and Answers for Marine Engineers

In this department the editors will answer questions from our readers regarding the operation and maintenance of boilers, engines and auxiliaries. This service is maintained for the benefit of those who desire practical information regarding engine-room problems or who are preparing to take examinations for a chief or assistant engineer's license.

Corrosion Fatigue

Q.—What in general is meant by the term "corrosion fatigue," and where would it be considered in marine engineering?

A.—Corrosion fatigue is a term applied to fatigue action on stressed members accompanied by corrosive action due to the presence of moisture or other corroding media. It has been found that the fatigue action on steel caused by cyclic stress is considerably accelerated by the presence of moisture. Also the character of the water, particularly as to its salt content, has a material effect upon the intensity of the action. There are, therefore, various considerations that can be given to reduction or avoidance of corrosion fatigue; some of these may be briefly stated as follows:

(a) If corrosive conditions are present, select the available material which is known to have the best corrosion-fatigue resistance. Monel metal or stainless steel, for instance, may be used instead of ordinary steel.

(b) Endeavor to protect the stressed part from the presence of water, by protective lining, coatings, etc., or by arrangements whereby water is kept away from the portions subjected to greatest stress—inside calking of riveted seams of boilers, bronze or rubber protection of outboard shafts, etc.

(c) Where water or corrosive liquid is present, treat same with suitable chemicals so that it is in a condition least likely to cause corrosion. A pH of 9 to 10 is desirable.

(d) Design parts so as to avoid stress concentration as much as possible.

(e) Allow a suitable and adequate margin of safety for any parts that may be especially subjected to conditions which may cause corrosion fatigue.

Corrosion-fatigue cracks may be found in outboard shafting, on piston rods of Diesel engines which are water cooled, on highly stressed rods, bolts, etc., which are subject to a spray of moisture or a drip. This sometimes may happen to coupling bolts on a leaky joint. It has been met with in steel turbine blading where the moisture of the steam supplies the corrosive medium. Various parts of boilers and pressure vessels at points where there is stress concentration may also exhibit these cracks. The rapid failure of stressed steel parts in various chemical operations may be explained by corrosion fatigue. The cyclic stress required to produce fatigue may in some cases be produced by vibrations. This may occur in parts of aircraft and automotive equipment and is often caused by unbalanced parts. The cracking of rails is generally due to fatigue and sometimes corrosion-fatigue conditions are presented.

Turbine Deposits

Q.—Can you tell me what in general is the cause of deposits on turbine blading and how these may be prevented or removed?

A.—Deposits on turbine blading are caused by carry over of salts of various kinds by the steam. Where priming is encountered particles are carried over with the steam and deposit themselves on the blading at various points. Some of the deposit usually when accompanied with oil may be fairly soft. At other times it is quite hard and resembles a deposit of boiler scale. Under adverse conditions this may build up to such an extent as to cause material loss in efficiency. Where boiler water is properly treated, boilers kept clean and priming avoided, such deposits ordinarily do not form on marine turbines to any considerable extent. When deposits do form, the injection of certain light mineral oils into the turbine has been resorted to to loosen up and remove same. These oils are such that they evaporate and do not get into the boilers. In other cases turbines are washed out with hot alkaline water.

The presence of moisture in the steam is responsible for turbine blade deposits but superheaters do not prevent the deposits since under certain conditions the particles of contamination are carried through the superheater. It has recently been discovered* that high concentration of sodium hydroxide (caustic) in the boiler water under priming conditions is mainly responsible for the building up of turbine blading deposits and the presence of sulphates neutralizes or lessens the action of the caustic.

Due to the fact that sodium hydroxide salt absorbs a certain amount of water, its particles, when carried over, have a pasty consistency which causes it to stick to the blading surfaces and this also will cause otherwise dry particles to build up on this foundation. The other salts encountered in sea water are carried over in the shape of solid particles like powder and do not have the sticky characteristic. Hence it has been found that by a proper control of feed-water conditioning, whereby the proportion of caustic is reduced and sulphates are introduced, the tendency to build up blading deposits can be materially reduced. On the other hand, if there is concentration of caustic accompanied by priming and with relatively little sulphate present, favorable conditions for building up turbine deposits will be present.

The main operating conditions to keep blading clean are (a) to prevent priming as far as possible in the boiler by keeping boilers clean, and (b) to carry relatively low caustic alkalinity and when caustic is present provide sulphates so as to maintain a ratio of about 4 of sulphate to one of caustic. The presence of chlorides and silicates tends to decrease formation of deposits and their presence may reduce the ratio of sulphate required.

In marine work the usual condenser leakage will provide enough sulphate if caustic is kept low, but it may

* Paper by F. G. Straub, A. S. M. E. Transactions, November, 1935.

be necessary with high pressures and tight condensers to introduce sulphate in some way.

When deposits on turbine blading are experienced it would be advisable to investigate the feed-water conditioning and determine whether any tendency to prime can be lessened.

Superheaters and Reheating

Q.—Has reheating been attempted in marine installations and is there any gain as compared to superheating?

A.—Reheating, as far as is known, has not been tried out in marine installations. Reheating supplies heat to dry the steam at an intermediate point in the expansion of the steam thus reducing the moisture in the low-pressure turbine thereby securing better economy and also avoiding other undesirable conditions due to excessive moisture. Its effect is similar to raising the superheat but this is accomplished without increase of temperature of the initial steam. Reheating no doubt improves economy but it also adds complications and when a superheating temperature of 730 degrees F. is used it is usually not considered justified until a pressure of about 700 pounds is used.

The aim would be to supply extra heat to the steam going to the low-pressure turbine in sufficient amount so that the moisture in the exhaust would not exceed about 10 percent. Reheating can be accomplished by taking the partially expanded steam back to the boilers to be heated by the furnace gases. This entails complicated piping and boiler construction and is hardly suitable for vessels. The other method is to do the reheating by means of superheated steam supplied to a heat exchanger located in the receiver pipe of the low-pressure turbine. This second arrangement is possible for marine installations, and if the design were carefully worked out, would not entail very great complication. Also with such an arrangement the reheat could be easily controlled for low power and maneuvering conditions.

The gain in economy due to reheating is a definite one and might easily be as high as 5 percent. Reheating by means of superheated steam also offers an opportunity of securing the benefit of high superheat without subjecting turbines, etc., to the same high temperatures because the heat for superheating is admitted at an intermediate point. If the turbine is divided into three units, the reheat steam could be supplied at two intermediate points and a very good temperature and moisture control would be possible. Owing to these possibilities series reheating on high-pressure marine turbines presents good possibilities of securing the benefits of high superheat without subjecting the turbines to excessive temperatures. Also owing to the possibility of controlling the temperature of the steam as it passes through the turbine the difficulties produced by excessive temperature at various places might be avoided and the expansion of various parts due to the great variations in temperature might be controlled to better advantage. It would seem possible that, with high-pressure turbines and 600 pounds pressure, by using a steam temperature of 730 degrees F. and reheating the steam at the entrance to the intermediate-pressure and the low-pressure turbine the same economy could be secured as when using say 900 degrees F. for the initial temperature. This lowering of the temperature would avoid certain difficulties and would enable less costly materials to be employed. It would reduce difficulties due to heat expansion. It is also quite possible that stage reheating by securing a better control of temperature and of liquefaction would, by avoiding leakage and re-evaporation, secure an economy improvement materially greater than that which is theoretically calculated.

Hence stage reheating for high-pressure marine turbines offers a good field for developing improved economy as well as greater freedom from defects due to expansion caused by the great variations in temperature. The introduction of high-pressure steam, i.e., above 500 pounds, on vessels may in the near future bring with it arrangements for reheating so as to secure both the economical and practical operating advantages which this appears to possess.

Single or Double Reduction Gear

Q.—Does double reduction gear secure any decided gain in economy over single reduction? Why are double gears used in some cases and single in others?

A.—Double reduction gear is utilized on vessels where there is too great a difference between the propeller speed and the turbine speed to permit the reduction to be made in one stage. Suppose we have a cargo vessel whose propeller speed is 100 revolutions per minute and it is desired to use turbines operating at 3000 revolutions per minute. This calls for a reduction of 30 to 1. To secure this in one reduction would entail a gear wheel too large to be considered. However, with two reductions, say 5 to 1 and 6 to 1, this can be accomplished readily. As the efficiency of the gear set is about 98 percent, the mechanical loss due to the extra reduction is not great and it is materially smaller than the gain in efficiency of the propeller and the turbine. On account of limitations of size and position of shafts, single reduction sets are limited to about 12 to 1 reduction.

If good propeller conditions can be obtained at 200 revolutions per minute, this would permit a turbine speed of 2400 revolutions per minute. Such conditions might present themselves on naval vessels and other high-speed vessels and single reduction may there be used, as they are in practice. It is a question of balancing the gain in propeller and turbine efficiency of a higher ratio against the loss of the double gear and the extra cost weight and space which the double reduction gear would entail.

Where space and weight are at a premium the slight gain due to the double reduction gear is usually rejected in favor of a single reduction with less complication. The gain in economy by going to a double reduction set is not likely to be more than 4 percent and for many services the complications entailed do not justify using the double reduction. Claims are sometimes made that the single reduction is as economical as the double reduction, but this is hardly justified. The increased ratio between turbine and propeller speed secured by the double reduction will secure some additional economy but the price paid for it may not always justify its use.

The question of whether to use a single or a double reduction will also be affected by the turbine to be used. If a low-speed turbine is to be installed, all the reduction desired may be secured in one step; but if high-speed turbine, 3000 revolutions per minute, or above, is to be used, a double reduction is often imperative to obtain a reasonable propeller speed.

Hence, for low-powered vessels, where there is ample space and weight available, double reduction gears would be used in order to secure the best economy from high turbine and low propeller speeds.

For high-powered vessels, where space and weight limitations enter more into consideration, the single reduction would be employed, thereby sacrificing some slight economy but avoiding some extra weight and complication, and possibly also securing some greater reliability.

Bethlehem Presents Handbook on Steel Plates

STEEL PLATES. Size 6½ by 9¼ inches. Pages, 362. Bethlehem, Pa., 1935: Bethlehem Steel Company. Price, $1.00.

"Steel Plates", a 362-page thoroughly modern ready-reference handbook, for designers, fabricators, engineers and consumers of steel plates and flanged-plate products, just published by the Bethlehem Steel Company, is designed to provide, in one complete volume, all the necessary working data, such as tables, specifications, general engineering and metallurgical information, helpful to designers, fabricators, and other users of steel plates, flanged-plate products and tubes. In it the subject matter is technically though simply treated, from details of manufacture in a word and picture story to the various applications of these products in tanks, stills, pressure vessels, cars, locomotives, ships, barges, boilers, buildings, bridges, etc., and many special applications.

Under each of its five main divisions is correlated all the pertinent data thereto, making it unnecessary to refer to other sources for specific information: Part 1 is concerned with manufacture, specifications, tabulated data and applications; Part 2 covers flanged and dished heads; Part 3 deals with tubes; Part 4 takes up boiler design, riveted joints, welding, etc.; Part 5 includes indispensable engineering tables, such as functions of numbers, natural trigonometric functions and so on; and for convenient recording of data for future reference blank cross-section sheets are inserted next to the index.

Personal

Major William E. R. Covell of Panama will succeed **Major W. D. Styer** as district engineer in June, 1936. Major Styer will succeed Major Covell at Panama.

Captain W. B. Armit has been appointed assistant marine superintendent for the **Canadian National Steamships,** Montreal, Que., with offices at Halifax during the winter.

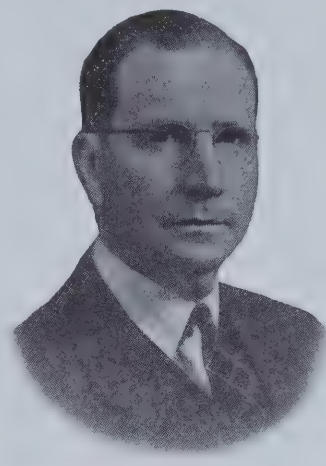
Samuel T. DeMilt was re-elected president of the **New Orleans Steamship Association** at the recent annual meeting of that organization. The coming term will be his twenty-fourth year as president. Mr. DeMilt has been the first and only president of the association.

John McAuliffe, president of the **Isthmian Steamship Company,** New York, was elected a director of the **Maritime Association of the Port of New York (Maritime Exchange),** at a meeting of the directors on December 10. Mr. McAuliffe fills one of the new memberships on the board.

Frank A. Muth recently was appointed superintendent of the **Seventeenth District, United States Lighthouses,** with headquarters at Portland, Ore. Mr. Muth previously was located in the Third Lighthouse District in New York and as assistant superintendent of the Eighth District at New Orleans, La. He has been in the Lighthouse Service 24 years. He is a past president of the Louisiana Section of the **American Society of Civil Engineers,** past president of the **Engineers Club,** and is a member of the **Propeller Club, Rotary Club, Society of American Military Engineers** and **American Society of Civil Engineers.**

John J. Kelleher, who has been in charge of **United Fruit Company** affairs in New York City for the last three years, was appointed vice-president in charge of the transportation and domestic division at a meeting of the board of directors held in Boston, Mass., recently. Mr. Kelleher joined the **United Fruit Company** in New Orleans in 1906.

R. R. Tinkham, whose appointment as chief engineer of the **Bureau of Lighthouses,** Washington, D. C., was announced recently, was graduated as a civil engineer from the University of Michigan, Class of 1905. Mr. Tinkham spent the next seven years with three industrial and engineering corporations in Detroit, Mich., as a structural designing engineer and superintendent of construction. He then joined the **United State Lighthouse Service,** where he served for the next 23 years as follows: Assistant superintendent of the Eleventh District, Detroit, Mich.; assistant superintendent of the Sixteenth District, Ketchikan, Alaska; assistant superintendent of the Third District, New York; assistant superintendent of the Eighth District, New Orleans, La.; superintendent of lighthouses, in charge of the Nineteenth iDstrict, Honolulu, Hawaii, and superintendent of Lighthouses, in charge of the Seventeenth District, Portland, Ore. He remained in the latter position until October 1, 1935, when he was appointed chief engineer of the Service at Washington, D. C. Mr. Tinkham is a member of the American Society of Civil Engineers.



R. R. Tinkham

Captain Daniel B. Hutchings and **William M. Campbell,** who have been acting United States steamboat inspectors in Seattle, have received permanent appointments to the positions. Captain Hutchings was appointed acting Seattle inspector of hulls in February, 1933, succeeding **Captain Donald S. Ames,** and Mr. Campbell was appointed acting inspector of boilers in August, 1933, succeeding **Thomas Short.**

Engineering Personnel

M. Mumma has been transferred to the *Manoa* of the **Matson Navigation Company,** San Francisco, as third assistant engineer.

James Blethen, third assistant engineer on the *M. O. Chandler* of the **Los Angeles Steamship Company,** Wilmington, Cal., is ill in the marine hospital. **Frank Brannan** is now second assistant engineer on the *M. O. Chandler.*

The following changes have been made in the **United Fruit Company** at San Francisco: **E. Perey** has been promoted to first assistant engineer on the *Chiriqui* with **Richard Sheilds** as second assistant engineer. **Maurice Hegarty** has been promoted to third assistant engineer on the *Talamanca* and **S. T. Gordon** to second electrician.

Guy R. Lord and **L. E. Landers,** formerly with the Dollar Line, are now working for the Panama Canal Commission as engineers on their tugs.

Fred Wickdahl is first assistant engineer on the steamship *Maui* of the **Matson Navigation Company,** San Francisco, with **Ernest Oribin** as second assistant engineer and **Jesse Brunbrook** as third assistant engineer.

Wallace W. Herne is now on the *Golden Coast* of the **Oceanic & Oriental Navigation Company,** San Francisco, as third assistant engineer, **R. C. Widner** having been promoted to second assistant engineer. **Lee Richardson** is still first assistant engineer.

Joe Ittura has been transferred to the *General Pershing* of the **States Steamship Company,** Portland, Ore., as chief engineer. **F. J. Schroeder** is third assistant engineer on the *Washington;* **Fred Clarks** is making a trip as first assistant engineer on the *San Clemente* and **D. E. Ellington** as second assistant engineer.

E. Houckuli is now third assistant engineer on the *Golden Cloud* of the **Matson Navigation Company,** San Francisco. **Howard George** has returned as chief engineer after a long illness. **Henry Wolters,** port engineer, is away east looking after their laid up ships getting them ready for service. **Otto Landgraf** is very ill in the Marine Hospital at San Francisco. **Taylor Anderson,** who was also ill, is improving. He was taken off the *Admiral Halstead.* While he is ashore **James Hall** is acting chief engineer.

E. J. Haddon is now third assistant engineer on the *Golden Hind* of the **American-Hawaiian Steamship Line,** San Francisco. Other changes in the American-Hawaiian fleet are as follows: **E. A. Kelly** is third assistant engineer and **V. F. Ellsworth** junior third assistant engineer on the *Oregonian.* **L. Nasey** is now third assistant engineer on the *Golden Dragon.* **K. A. Sturges** has joined the *Montanan* as junior third assistant engineer. **Larry Dake** is back on the *Texan* as third assistant engineer. **Martin Wiggen,** chief engineer on the *Dakotan,* has moved **Bob Gray** up to first assistant engineer and **Phillip Murry** as second assistant engineer. **F. H. Oberding** has been transferred to the *Ohian* as second assistant engineer.

Obituary

George Edward Corey, marine surveyor and pioneer Seattle resident, died on December 15 after an illness of four months. Mr. Corey, well known on the Seattle waterfront, was born in Washington, D. C., and went to Seattle in 1889.

Charles D. Snedeker, president of the **Perth Amboy Dry Dock Company,** Perth Amboy, N. J., died recently of a heart attack. Born in New Brunswick, N. J., Mr. Snedeker was educated in public schools and at the New Jersey Business College. He became president of the Perth Amboy Dry Dock Company in 1928, after serving as secretary and treasurer for 34 years. He had also been president of the **Board of Water Commissioners** of Perth Amboy and was chairman of the **Perth Amboy Postal Savings Drive** during the World War. Mr. Snedeker was a fellow of the **American Geographical Society,** the **Maritime Association of the Port of New York,** the **New Jersey Historical Society,** and the **Holland Society** of New York.

Joseph D. Tomlinson, vice-president of the **American-Hawaiian Steamship Company,** died on December 24 at his home, 12 Cranford Avenue, Cranford, N. J., after a short illness. Mr. Tomlinson formerly was connected with the **International Mercantile Marine Company,** New York. He came to the American-Hawaiian Company in 1906 as an assistant to the operating manager. About 1914 he was appointed a superintendent, and in 1923 was made a vice-president, which position he held until his recent death. Mr. Tomlinson was 64 years of age.

Harry Howard Raymond, president of the **Colombian Steamship Company, Inc.,** New York, and former chairman of the **Atlantic Gulf and West Indies Steamship Lines,** New York, died at his summer home in Yarmouth, N. S., on December 27, at the age of 71 years. Mr. Raymond was born in Yarmouth. He attended the **Yarmouth Academy,** but at the age of seventeen began the career that eventually made him an outstanding figure in the shipping business in the United States. His first job was with the **Clements Steamship Company.** He came to the United States in 1884 and found employment with the **St. John's River Transportation Company,** but two years later transferred to the **Mallory Line** as purser of the *State of Texas.* In 1888 he was appointed traveling agent of the Mallory Line, with headquarters in Jacksonville, Fla. When the company inaugurated its service between New York and Brunswick, Ga., he received appointment as general traveling agent with headquarters in Atlanta. The next year Mr. Raymond was appointed chief clerk to **C. H. Mallory & Company,** in New York City, managing agents of the Mallory Line. He subsequently became general manager and, in 1907 became vice-president and general manager of both the Clyde and Mallory steamship companies after a reorganization. Mr. Raymond was elected president of the **Clyde and Mallory Lines** in 1915, and continued in that position until 1927, when he was made chairman of the board of the Atlantic, Gulf and West Indies Lines. He was appointed vice-chairman of the **Shipping Control Committee** of the **United States Shipping Board** in January, 1918, and his duties had much to do with the overseas transportation of troops and war materials. Mr. Raymond advocated a strong American merchant marine and one of his major achievements was the construction of a modern fleet of six passenger and cargo vessels for the Clyde-Mallory Lines' services between New York and Southern ports. More recently he was instrumental in the construction of two passenger steamships for the Colombian lines. He was an honorary vice-president of the **American Bureau of Shipping.**

H. H. Raymond

Daniel J. Murphy, who had charge of all stevedoring and army transport work for the United States Government during the World War, died of a heart attack at his home in Marion, Pa., on December 2. Mr. Murphy was president of **Murphy, Cooke & Company,** stevedore contractors of Philadelphia, which was founded by his father and with which he was associated since 1888. During the war he also had charge of stevedore work on Belgian relief activities and shipped ammunition for the Italian Government. Mr. Murphy was 68 years of age.

Ship Construction and Repair News

Proposed work
Bids asked
Bids received
Contracts awarded

Construction of Large River Passenger Steamer Proposed

Undisclosed Pittsburgh financiers have approved plans for the construction of a passenger and freight steamer, what may be known as a super packet for the Pittsburgh and New Orleans trade. If negotiations are successfully terminated, construction of this vessel may be started early in the year.

The contemplated steamer will have a length of about 400 feet, a beam of 90 feet, and a depth of 7 feet. She will be of the triple screw type, with engines developing 1500 horsepower.

December Ship Construction Contracts

Six tankers—Two 15,000-ton and two 12,000-ton tankers for the Pan-American Petroleum Corporation, New York, awarded as follows: The two 15,000-ton to the Sun Shipbuilding & Dry Dock Company, Chester, Pa., and the two 12,000-ton to the Federal Shipbuilding & Dry Dock Company, Kearny, N. J. Two 15,000-ton tankers for the Socony-Vacuum Oil Company, New York, awarded on the same day to the Sun Shipbuilding & Dry Dock Company, Chester, Pa.

One liner, cabin, similar to the *Manhattan* and *Washington*, for the United States Lines, New York, awarded to the Newport News Shipbuilding & Dry Dock Company, Newport News.

Four tankers, 1100 tons, for the Conners Marine Company, Inc., awarded to United Dry Docks, Inc., New York.

Three ferryboats for the Department of Plant and Structures, New York, awarded to United Dry Docks, Inc., New York.

One boat, derrick, for the United States Engineer Office, First New York District, New York, awarded to the Sparrows Point Yard of the Bethlehem Shipbuilding Corporation, Ltd., Baltimore, Md.

Four barges, 195-foot, steel, for the Campbell Transportation Company, Pittsburgh, Pa., awarded to the McClintic-Marshall Corporation, Pittsburgh, Pa.

Six barges, steel, standard, coal, for Tri-State Transportation, Inc., Morgantown, Pa., awarded to the American Bridge Company.

Three boats, 45-foot survey, for the United States Engineer Office, Louisville, Ky., awarded to the Charles Hegewald Corporation, New Albany, Ind.

One barge, 195-foot, for the Campbell Transportation Company, Pittsburgh, Pa., awarded to the Treadwell Construction Company.

One barge, steel, coal, for the Oliver Transportation Company, Philadelphia, Pa., awarded to the Dravo Contracting Company, Pittsburgh.

One hull, steel, for the steamer *Kiwanis*, of the Greene Line Steamers, Cincinnati, O., awarded to the Dravo Contracting Company, Pittsburgh.

One barge, steel tow oil, for the Pfeifer Oil Transportation Company, Inc., North Tonawanda, N. Y., awarded to the Truss-Weld Division of United Dry Docks, Inc.

One barge for the Hawaiian Pineapple Company, awarded to the San Francisco Plant of the Bethlehem Shipbuilding Corporation, Ltd.

One barge, steel, for Theodore Brent, New Orleans, La., awarded to L. F. Alexander Company, New Orleans, La.

One towboat for the Monongahela and Ohio Dredging Company, Pittsburgh, Pa., awarded to the Dravo Contracting Company, Pittsburgh.

Two launches, 40-foot motor, for the United States Engineer Office, New York, awarded to the firm of Jakobson & Peterson, Inc., N. Y.

Contract for Construction of United States Cabin Liner Awarded to Newport News

On December 16, the United States Lines, New York, signed a contract on that date with the Newport News Shipbuilding & Dry Dock Company, Newport News, Va., for the construction of a 23,000-ton cabin liner to operate with the *Washington* and *Manhattan*.

Because of Federal requirements for stability in damaged condition, bulkheading, etc., considerable changes in the design submitted by Newport News will be necessary. To provide for such structural changes, the original bid on December 7, of $11,600,000 was increased in the contract price to $11,900,000.

What will constitute practically a new design incorporating ideas of the owners will be developed by Newport News in the course of the next few weeks in conjunction with the owner's naval architect.

In the meantime, the Department of Commerce, Shipping Board Bureau, has withheld approval of the loan from its construction fund, pending receipt of the final design details. It is not expected there will be any material delay in the granting of the loan when the plans have been approved, since the administration has given every indication that it desires the ship to be built.

The contract as executed between the United States Lines and the Newport News Shipbuilding & Dry Dock Company takes into account the delay entailed by the development of the new design and does not become effective for a matter of six weeks or so.

Bethlehem Awarded Contract for Derrick Boat

A contract for furnishing all labor and materials and performing all work for constructing and delivering afloat one 35-ton derrick boat has been awarded to the Sparrows Point Yard of the Bethlehem Shipbuilding Corporation, Ltd., Baltimore, Md., at a price of $115,300 and a time of 150 days. Bids for the new construction were received on November 7 by the United States Engineer Office, First District, 39 Whitehall Street, New York.

The boat is to have a length, molded, 110 feet; a beam, molded, 40 feet, and a depth, molded, 10 feet. An oil burner of the assisted draft, mechanical type, is to be installed in each boiler furnace and in the boiler room, where directed, one vertical simplex pump, 7½ inches by 5 inches by 10 inches, or a similar pump having the same capacity, is to be installed.

Barge Contract

A contract for the construction of one steel barge has been awarded to L. F. Alexander Company, New Orleans, La., by Theodore Brent, New Orleans. The new barge is to have a length of 100 feet and a beam of 30 feet. The price involved was not given out.

Moore Yard Designing 12,500-Ton Arcform Tanker

Supplementing the item published in the December issue to the effect that the Moore Dry Dock Company, San Francisco, might shortly lay down several tankers of the arcform type with a view to selling them to some of the oil companies on the Pacific Coast, it is learned that the company is at present designing a 12,500-ton tanker on the arcform system similar to two now being constructed by the Federal Shipbuilding & Dry Dock Company, Kearny, N. J. It has not been definitely decided, however, to go ahead with the new construction at this time.

Barge Contract Awarded

The Campbell Transportation Company, Pittsburgh, Pa., recently awarded a contract to the McClintic-Marshall Corporation, Pittsburgh, Pa., for the construction of four 195-foot barges. Each barge will have a beam of 35 feet, a depth of 9.6 feet, and will have a capacity of 8600 barrels each. They will be of the arc-welded type, will be equipped with unloading pumps and piping and will be used in the local and long distance movement of petroleum products. The price involved was not made public.

Two Companies Place Orders for Six Ocean-Going Tankers to Cost Approximately $12,000,000

It is understood that the Pan-American Petroleum Corporation, New York, on December 23 placed contracts for the construction of two 15,000-ton tankers, and two 12,000-ton arc-form tankers. The latter vessels will be built by the Federal Shipbuilding & Dry Dock Company, Kearney, N. J., and the two 15,000-ton tankers by the Sun Shipbuilding & Dry Dock Company, Chester, Pa. So far as can be learned competitive bids were not taken on these vessels.

On the same day a contract for the construction of two 15,000-ton tankers was awarded by the Socony-Vacuum Oil Company, New York, to the Sun Shipbuilding & Dry Dock Company. The Sun Company submitted the low bid for the ships on December 16.

The four ships to be built by the Sun Company will be sister ships of the *Socony-Vacuum* and *Magnolia,* built by the New York Shipbuilding Company in 1933-1934. They will, therefore, have approximately the following principal dimensions:

Length overall	500 feet 1½ inches
Length between perpendiculars	484 feet
Beam, molded	65 feet 9 inches
Depth, molded	37 feet
Draft, molded, designed	29 feet 8⅜ inches
Displacement, molded	20,695 tons
Deadweight capacity	15,000 tons
Gross tonnage	9,511 tons
Net tonnage	5,894 tons
Main cargo tanks	4,349,000 gallons
Summer tanks	975,000 gallons
Shaft horsepower	4000
Speed	13¼ knots

The new vessels will be of two-deck design having a straight stem and cruiser stern and will be built on the Isherwood longitudinal bracketless system of construction. As specified, propulsion will be by a double-reduction geared turbine, designed to develop 4000 shaft horsepower at 75 revolutions per minute of the propeller shaft, taking steam at 375 pounds per square inch and 700 degrees F. temperature. Steam will be supplied by three A-type oil-fired watertube marine boilers, each designed to supply 19,000 pounds of steam per hour at 425 pounds per square inch in the drum and 700 degrees F. at the superheater.

The two 12,000-ton Pan-American Petroleum Corporation arcform tankers to be built at the Federal Yard will have an overall length of 445 feet, a beam, molded, 66 feet 6 inches, a draft of 28 feet, a displacement tonnage of 16,750, and a deadweight tonnage of 12,300. They are of twin bulkhead design and constructed from the builder's plans on the Isherwood arcform system. Propulsion will be by Allis Chalmers cross compound turbines, developing a normal shaft horsepower of 3000, with a maximum of 3300, with steam at the throttle of 375 pounds and 725 degrees. The reduction gear will be of the Farrell Birmingham double-helical, double-reduction type, developing normal revolutions per minute of 6000 high pressure, 4400 low pressure, and 90 shaft.

Steam will be supplied by two "D" type Foster Wheeler boilers, placed back to back, delivering steam at the superheater outlet at 400 pounds pressure and a total temperature of 750 degrees.

Delivery of all eight tankers is expected to be made in from 10 to 12 months' time.

New York City Ferryboats to Have Reciprocating Engine Drive

It is understood that reciprocating engine drive is to be installed in the three ferryboats, construction of which was authorized by the Department of Plant and Structures, New York City, on December 14, with United Dry Docks, Inc., New York. With this decision the contract price in effect will be $912,000 per ship.

The vessels will practically duplicate the ferryboat *Knickerbocker* built in 1931 for New York-Staten Island service. They will each have a length of 251 feet 6 inches, a beam of 46 feet, and a draft of 18 feet. Capacity will be provided for 2500 passengers. Propulsion specified for each vessel will be by two compound engines, each developing 2200 shaft horsepower, 22.5 inches by 50 inches diameter, with a stroke of 30 inches.

Proposals were received from three shipyards as follows:

Robins Dry Dock & Repair Company, Brooklyn, N. Y.

Bid As Per Specifications	(Alternative A Unaflow Engines)	(Alternative B Turbine drive)
Bids for One Boat		
$860,000	$890,000	$950,000
Bids for Two Boats		
$855,000	$885,000	$945,000

United Dry Docks, Inc., New York

Bids for One Boat		
$950,000	$970,000	$1,050,000
Bids for Two Boats		
$923,000	$950,000	$1,003,000
Bids for Three Boats		
$912,000	$925,000	$987,000

Brewer Dry Dock Company, Staten Island, N. Y.

Bids for One Boat		
$1,138,000	$1,158,000	$1,228,000

In explanation of the award to other than the low bidder, which was Robins Dry Dock & Repair Company, it was stated when the contract was signed that the low bid did not conform with PWA terms—and a contract could not be carried out by the company under the labor provisions of PWA.

New Chicago Ferry Company May Build Largest Lakes Ferryboat

The Vehicle Ferry Engineering Corporation, Chicago, which was recently formed at Chicago, is planning the construction on the Great Lakes of a radically new design of ferryboat. It is understood the company hopes to let contracts for the first ferry to cost approximately $1,150,000 within the next few months.

The boat will have a length of 400 feet, a beam of 72 feet, and will be driven by Diesel engines of about 7000 horsepower, connected directly to twin propellers. It will have a capacity of about 250 highway trucks or about 600 passenger cars.

The new company is headed by A. Miller McDougall, associated for many years in business with his father as leading designers, builders and operators of ships on the Great Lakes. Additional details will be published at a later date.

United Dry Docks to Build 1100-Ton Tankers

It is understood that a contract has been negotiated between the Conners-Marine Company, Inc., New York, and United Dry Docks, Inc., New York, for the construction of four 1100-ton molasses tankers. The vessels are intended for operation on the New York State Barge Canal between Buffalo and New York. The design was prepared by R. S. Haight, naval architect, 17 State Street, New York.

Barge Contract Awarded to Dravo

A contract for the construction of a steel coal barge has been awarded by the Oliver Transportation Company, Philadelphia, Pa., to the Dravo Contracting Company, Pittsburgh, Pa. The vessel is to have a length of 160 feet, a beam of 40 feet, and a depth of 16 feet. The price involved was not given out.

Derrick Boat Bids Asked February 3

Sealed proposals will be received on February 3 by the United States Engineer Office, Post Office Building, Chicago, Ill., for the construction of one 15-ton steel hull steam operated A-frame derrick boat, complete with one heavy-duty clamshell bucket. Additional details may be obtained by application.

Order for Six Coal Barges

A contract for the construction of six standard steel coal barges has been awarded to the American Bridge Company, Ambridge, Pa., by the Tri-State Transportation, Inc., of Morgantown, Pa. The barges will be of the usual coal-carrying type, 175 feet long, 26 feet beam, and 11 feet deep. The price involved was not given out.

American South African Line Asks Bids January 15 on Two Combination Passenger and Cargo Ships

Plans and specifications have been issued by the American South African Line, Inc., New York, covering the construction of one or two combination passenger and freight ships. Bids will be opened at the offices of the line on January 15, 1936, on one and two ships. The bids will be held by the owners until March 15, wher the decision on a contract will be annou ced.

The vessels will have the following principal dimensions:

Length overall	508 feet 6 inches
Length load waterline	500 feet 0 inches
Length between perpendiculars	480 feet 0 inches
Beam, molded	66 feet 0 inches
Depth, molded to awning deck	42 feet 0 inches
Load draft all seasons	27 feet 5½ inches
Displacement load draft	16,695 tons
Deadweight	9735 tons
Cubic capacity	480,000 cubic feet
Service speed	16¼ knots
Shaft horsepower	9000
Passengers	103
Officers and crew	92

Propulsion will be by compound double-reduction geared turbines, driving twin screws. Each propulsion unit will be of 4500 shaft horsepower. Propellers will run at 90 revolutions per minute. Steam will be supplied by two marine type watertube boilers, delivering steam at 400 pounds per square inch working pressure and 750 degrees total temperature.

Alternative bids are requested on Diesel propulsion machinery or any other type that may be suggested by the builders. Also alternative bids are asked on designs prepared by the builders other than the one submitted by the naval architect. Plans and specifications for the owners designs were developed by Gibbs & Cox, naval architect, 1 Broadway, New York.

The American South African Line has applied to the Shipping Board Bureau for a construction loan.

Morgan Steamship Dixie Reconditioning Completed Ahead of Schedule

The Morgan liner *Dixie,* which was damaged when driven on a Florida reef in a hurricane last September, has been extensively reconditioned and returned to service early in December. The work was carried out at the Robins Dry Dock & Repair Company, Brooklyn, N. Y.

The entire bottom of the vessel was damaged from stem to stern, port and starboard. The reconditioning work included replacing 164 steel plates, together with all floors, longitudinal frames, keel, keelsons, and margin in way of same. The stern frame was repaired and replaced.

The main turbine was opened up, the rudder balanced, shafting removed and replaced, sterntube renewed, all realined and put in order. Auxiliaries were opened up and reconditioned. The rudder was renewed and streamlined, steering gear overhauled complete and four main watertube boilers rebricked. All piping systems throughout the ship, main and auxiliary steam, exhausts, and heating systems were cleaned and tested, and wiring renewed.

Other work included the installation of a submarine signal fathometer, lifeboat winches and gear, and a bar in the smoking room. The boat deck was extended at the aft end and a permanent swimming pool installed. All furniture was thoroughly reconditioned and refinished, with a large percentage renewed.

All alterations were carried out in compliance with the latest Bureau of Navigation and Steamboat Inspection.

Contract for the work was let on October 17 and scheduled for delivery December 20. The *Dixie,* however, was delivered to her owners on December 6, 14 days earlier than expected, and resumed service on December 11.

The reconditioned Dixie ready for service

Dravo to Build Hull for Steamer Kiwanis

A contract for the construction of a steel hull for the packet steamer *Kiwanis* has been awarded to the Dravo Contracting Company, Pittsburgh, Pa., by the Greene Line Steamers, Cincinnati, O. The new hull will be assembled at a point below the boat and when finished will be launched and sunk. The *Kiwanis* then will be placed in the river directly above the new hull, which will be pumped out and pulled back on the ways to securely fasten the old hull into the new shell.

The air space between the two hulls will act as watertight bulkheads and at the same time will permit doubling the cargo capacity of the boat. Captain Jesse Hughes of the Greene Line is in charge as overseer.

United Gets Contract to Build Oil Barge

The Pfeifer Oil Transportation Company, Inc., North Tonawanda, N. Y., has awarded a contract to the Truss-Weld Division of United Dry Docks, Inc., New York, for the construction of one steel tow oil barge of 250,000 gallons capacity. The barge is to be a duplicate of two recently launched by the Truss-Weld Division for the Coastwise Oil Transfer Company of Boston, and is to be built on the free-flow frame system of all welded construction. It is to have a length of 116 feet, a beam of 36 feet, and a depth of 10 feet.

The pumping equipment will consist of two 750-gallon-per-minute Viking pumps, connected to two 6-inch pipe lines and driven by two V-8 Ford heavy duty type engines with Diamond roller chain drives.

The vessel will be used to carry gasoline or light oils in river, harbor, New York State Barge Canal and limited coastwise service and will be classed A-1 American Bureau of Shipping for this service

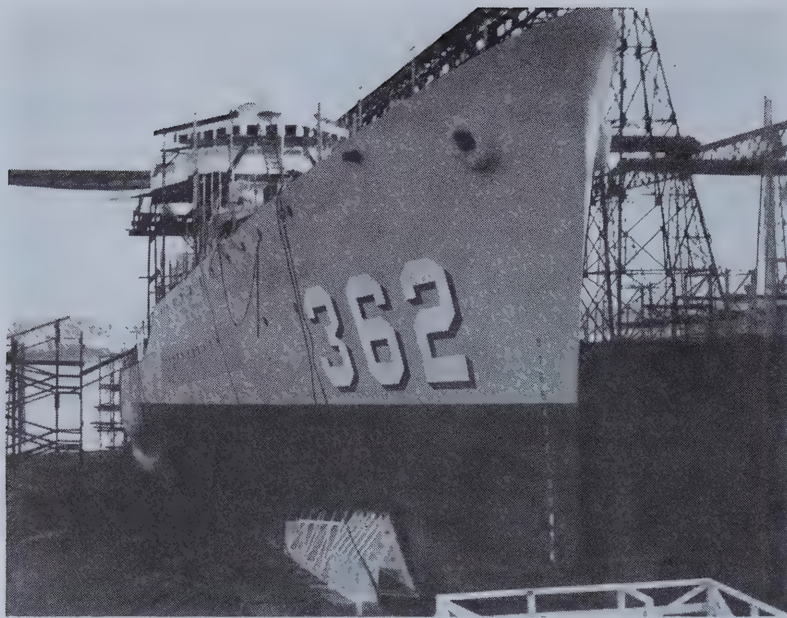
Towboat Contract

The Monongahela and Ohio Dredging Company, Pittsburgh, Pa., has completed plans and specifications for the construction of a towboat, as an addition to its present fleet for service on Pittsburgh waters. The company has already awarded a contract to the Dravo Contracting Company, Pittsburgh, Pa., for the construction of a steel hull, 90 feet long, 22 feet beam, and 5 feet deep.

When the hull is completed the dredging company will build a wooden cabin with cooking and sleeping quarters for a double crew. It will be equipped with a 300-horsepower internal combustion engine, two capstans and other modern machinery. The total costs are placed at approximately $45,000.

Barge Contract Awarded

A contract for the construction of one barge for the Hawaiian Pineapple Company recently was awarded to the San Francisco Plant of the Bethlehem Shipbuilding Corporation, Ltd., at an undisclosed price.



Destroyer leader Moffett prior to launching

Three Destroyers Launched in December

Two 1850-ton destroyer leaders, the *Porter,* and the *Moffett,* and one 1500-ton destroyer, the *Cummings,* were launched early in December. The *U.S.S. Cummings,* second of four destroyers under construction for the United States Navy by United Dry Docks, Inc., was launched on December 11 at the company's Staten Island Plant, Mariners Harbor, Staten Island, N. Y. This vessel is of the same class as the 1500-ton destroyer *Mahan,* launched on October 15.

The *Cummings* was sponsored by Mrs. William Wirt Mills of Staten Island, niece of the late Lieutenant Commander Andrew Boyd Cummings, U.S.N., and wife of the Honorable William Wirt Mills, commissioner of the Board of Taxes and Assessments of the City of New York.

At the Fore River Plant, Quincy, Mass., of the Bethlehem Shipbuilding Corporation, Ltd., the destroyer leader *Moffett* slid down the ways on December 11, the second naval vessel to take the water on that date. Preceded by the *Phelps* and the *Clark,* the *Moffett* is the third of a group of four ships of the same design now building at the plant. The *Moffett* was sponsored by Admiral Moffett's daughter, Miss Beverly Moffett of Washington, D. C.

On the following day, December 12, the destroyer leader *Porter* was successfully launched under the sponsorship of Miss Carlile Patterson Porter, daughter of Brigadier General David D. Porter, adjutant of the Marine Corps. The destroyer was named in memory of Miss Porter's great-great-grandfather — Commodore David Porter. This vessel is of the 1850-ton destroyer leader class, has a length of 372 feet and a beam of 36 feet 10⅝ inches.

Approval of Norfolk Ferryboat Given by County Board

A contract for the construction of a new ferryboat for the Norfolk County Ferries, Portsmouth, Va., was approved at the December joint meeting of the council and county board. If original plans and specifications for the new boat stand, she will have an overall length of 175 feet 3 inches, an extreme beam of 59 feet 8 inches, and a depth of 14 feet 3 inches, with 8 feet 6 inches draft.

If the bids heretofore submitted are approved as they were last summer, the Maryland Dry Dock Company of Baltimore, Md., will build the boat, to be named *Norfolk County,* and Fairbanks-Morse will supply the Diesel engines, with Elliott generators, exciters and main motor. The Maryland concern bid $174.-174 for construction of the boat and will guarantee delivery within seven months from the signing of the contract.

Maryland Dry Dock Refitting Tanker

The tanker *Walter Miller,* which was acquired from the Continental Steamship Company, Baltimore, Md., by the Pennsylvania Shipping Company, Philadelphia, Pa., recently, has been docked at the yard of the Maryland Dry Dock Company, Inc., Baltimore, for alterations. The vessel is to be fitted for carrying casing head gasoline.

The tanker, which was built at Oakland, Cal., in 1920, has a gross tonnage of 7294 and a length of 425 feet.

Contract for Harbor Craft

A contract for the construction of six Coast Guard 55-foot harbor craft has been awarded to the Russell Dry Docks, Inc., Long Island City, New York. The price involved, however, was not given out.

Bids Asked for 20-inch Pipe-Line Dredge

With reference to an item published in the December issue to the effect that new bids would be called shortly by the United States Engineer Office, Louisville, Ky., for the construction of one self-propelled 20-inch pipeline dredge, it is learned that the date for the receipt of bids has been set for January 21, 1936. The dredge, which is to be designated *Jewett,* is to be of the twin-screw type, equipped with internal combustion engines, developing 1500 horsepower. It will have an overall length of 272 feet, a beam of 48 feet, and a depth of 8.6 feet.

To Recondition Ferryboat

The Norfolk County Board has appropriated the sum of $30,000 from its depreciation fund to defray the cost of putting the steamer *New York* of the Norfolk County Ferries, Portsmouth, Va., in first-class condition for service next year. The Old Dominion Marine Railway Corporation, Norfolk, Va., submitted a low bid of approximately $18,000 for renewing most of the steel hull of the *New York.* In addition, it may be necessary to completely replace an apron on the vessel besides other work that may run the cost to $25,000.

United to Repair S. S. Southern Cross

A contract covering repairs to the Munson Line steamship *Southern Cross* has been awarded to United Dry Docks, Inc., New York, at a price of $19,800. Bids for the work were received in New York on December 20 and one other tender was submitted by the Todd New York Dry Dock Company, at a price of $21,850.

To Build Three Survey Boats

A contract for the construction of three 45-foot survey boats has been awarded to the Charles Hegewald Corporation, New Albany, Ind., at a price of $28,100 and a time of 150 days. Bids for the new boats were received on November 12 by the United States Engineer Office, Louisville.

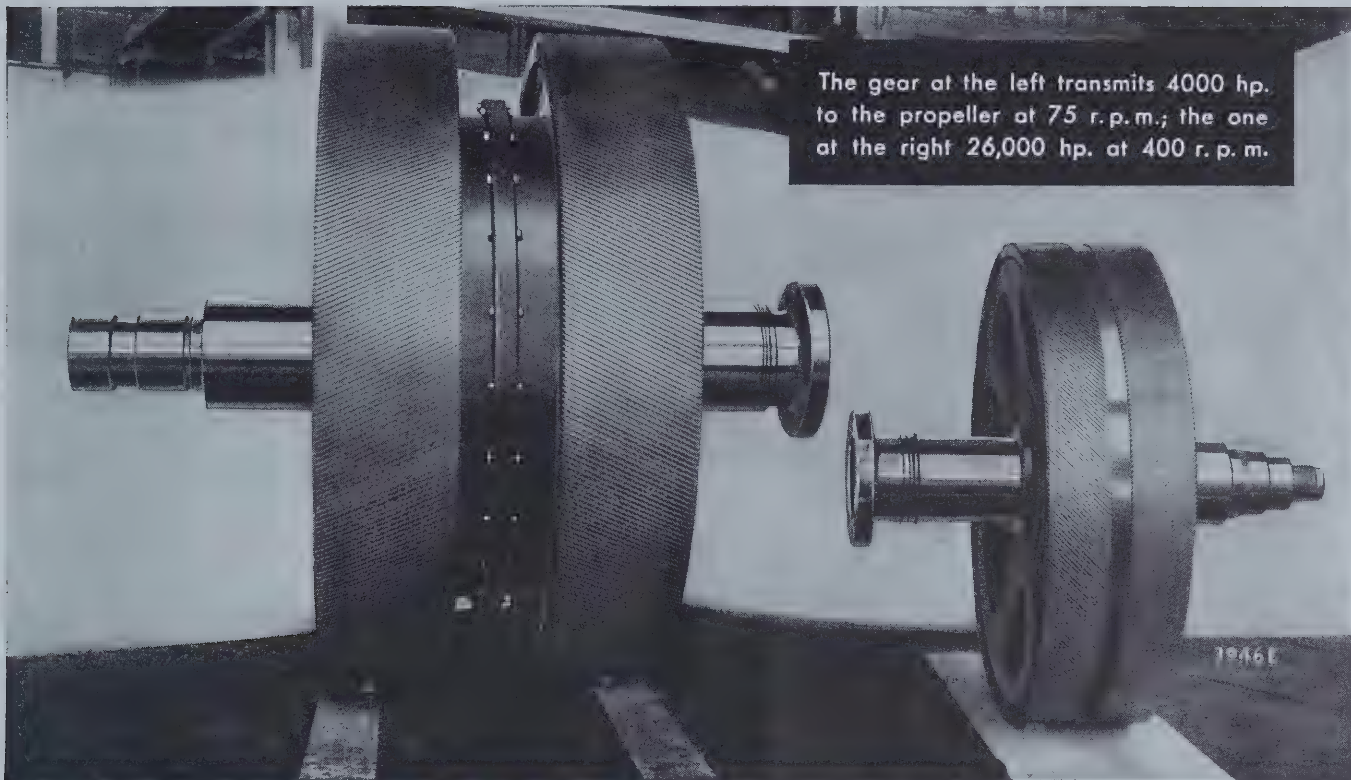
The new boats are to be equipped with 152-horsepower Buda engines.

Boiler Contract Awarded

The United States Engineer Office, Box 59, Louisville, Ky., has awarded a contract to the Joseph P. Casey and Foundation Waterproofing Company, Chicago, Ill., for furnishing and installing a watertube boiler on the United States towboat *Cayuga,* at a price of $39,000. Bids for the installation were received on October 11.

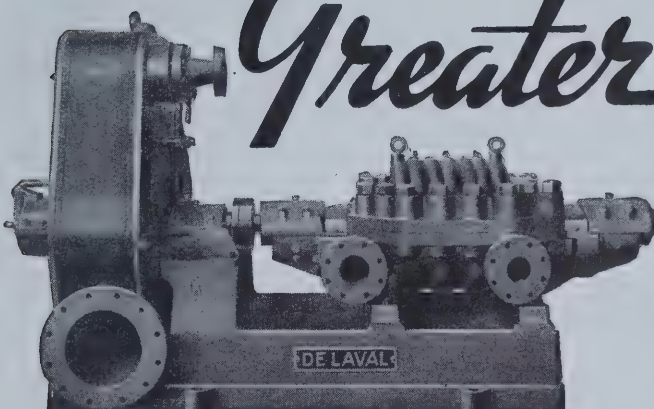
Proposal to Build Ferryboat

The county clerk at Suisun, Cal., has applied to the WPA officials in an effort to secure funds for a new ferryboat to replace the Grizzly Island ferryboat in Northern Solano. As soon as the funds are appropriated the boat will be built at Vallejo, Cal.



The gear at the left transmits 4000 hp. to the propeller at 75 r. p. m.; the one at the right 26,000 hp. at 400 r. p. m.

Greater POWER *from* LESS SPACE, WEIGHT AND FUEL



Above—High pressure, turbine driven boiler feed pump as installed on recent passenger liners; 825 g. p. m. against 500 lb. gage at 2700 r. p. m.

Below—One of a number of 300 kw. geared turbine driven auxiliary generating sets installed on bulk oil tankers.

DE LAVAL GEARED TURBINES, with turbine driven auxiliaries, have enabled marine engineers to progress from the 1.35 lb. per s. hp. hourly fuel consumption of the MAURETANIA, for example, to the 0.61 lb. of the G. HARRISON SMITH, although the power developed by the latter vessel is 20 times the smaller. The G. HARRISON SMITH is propelled by **DE LAVAL COMPOUND GEARED TURBINES** using steam at 400 lb. gage and 750° F.

De Laval Geared Turbines and turbine driven auxiliaries have been adapted successfully to all classes of ships, such as the Standard Transportation Co., Sinclair Navigation Co. and Socony-Vacuum bulk oil tankers, the Baltimore Line reconditioned passenger liners, the Sea-train freighters, Coast Guard cutters, etc., as demonstrated by the outstanding economy and reliability of these ships.

Results which we will guarantee will be submitted upon learning your requirements.

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De Laval *Steam Turbine Co.,* Trenton, N. J.

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Tanker Moran Repair Award

Bids were received on December 6 by the Pennsylvania Shipping Company, Philadelphia, Pa., covering repairs to tanker *D. J. Moran*, as follows:

Name and Address	Sections 1, 2, 3	Days	Sections 1, 2, 3, 4	Days
Maryland Dry Dock Inc., Baltimore, Md.	$14,441	14	$28,882	14
Todd Dry Docks, Inc.. (New Orleans, La.) (Mobile, Ala.) (each) (Galveston, Tex.)	16,500	10	34,850	22
Bethlehem Shipbuilding Corporation, Ltd., New York	17,500	10	30,300	15
Newport News Shipbuilding & Dry Dock Company, Newport News, Va.	....	..	35,602	10
Alabama Dry Dock & Shipbuilding Company, Mobile, Ala...	23,717	15	42,299	18

A contract for the work was awarded to the Maryland Dry Dock Company, Inc.

Bethlehem to Repair Tanker Tahama

Bids were received on December 12 by the Socony-Vacuum Oil Company, Inc., New York, covering repairs to tank steamship *Tahama*, with the following results:

Name	Price	Days
Bethlehem Shipbuilding Corporation, Ltd.	$9,500	10
	11,000	7
Maryland Dry Dock Company, Inc.	11,959	6
	13,559	5
Todd New York Dry Dock Company	12,660	8
	14,840	5
Sun Shipbuilding & Dry Dock Company	14,263	10
	15,400	8
United Dry Docks, Inc.	15,883	10
	19,514	8

Note: Bids were submitted on the basis of regular working days and also for overtime.

The Bethlehem Shipbuilding Corporation, Ltd., was awarded the contract.

Tanker Veedol Repairs

A contract covering repairs to the Tide Water Associated Transport Corporation tank steamship *Veedol* has been awarded to the Todd New York Dry Dock Company at a price of $4455. Bids for the work were received in New York on December 17, and other tenders submitted were as follows:

Name	Price
Brewer Dry Dock Company	$6223
United Dry Docks, Inc.	6565
Atlantic Basin Iron Works	7240
Ira S. Bushey & Sons, Inc.	8577

Bids for Tanker Repairs

Bids were received on December 18 by the Socony-Vacuum Oil Company, New York, covering repairs to the steam tanker *Liebre*, with the following results:

Name	Price	Days
Todd New York Dry Dock Company	$15,300	9
Maryland Dry Dock Company, Inc.	19,354	10
Bethlehem Shipbuilding Corporation, Ltd.	21,000	9
United Dry Docks, Inc.	21,350	10
Sun Shipbuilding & Dry Dock Company	23,000	9

Bull Line Vessel Repair

The Bull Line steamer *Margery* has been docked at the Baltimore Plant of the Bethlehem Shipbuilding Corporation, Ltd., Baltimore, Md., for a general overhauling.

Treadwell to Build Tank Barge

A contract for the construction of one 195-foot tank barge has been awarded to the Treadwell Construction Company of Midland, Pa., by the Campbell Transportation Company, Pittsburgh, Pa. The new barge is to have a capacity of 8500 barrels on a draft of 7.2 feet. The price involved, however, was not given out.

S. S. Florida Repair Bids

Bids were received on December 16 by Frank S. Martin & Son, marine engineers, New York, covering repairs to the Record Steamship Company steamship *Florida*, with the following results:

Name	Price	Days
United Dry Docks, Inc.	$20,381	16
Todd New York Dry Dock Company	35,523	17

U. S. S. Peary Repair Contract

A contract for extensive repairs to the *U.S.S. Peary* has been awarded to the Buffalo Marine Construction Corporation, Buffalo, N. Y., at a price of $38,500. Bids

Dredge Pump Contract

A contract for furnishing and delivering one 32-inch dredge pump has been awarded to the Fulton Iron Works Company, St. Louis, Mo., at a price of $8925. Bids for the new pump were received on December 16 by the United States Engineer Office, Memphis, Tenn., and other tenders submitted for the work were as follows:

Name and Address	Price
Hardie-Tynes Manufacturing Company, Birmingham, Ala.	$9,266
Steacy-Schmidt Manufacturing Company, York, Pa.	10,150
Pettibone Mulliken Company, Chicago, Ill.	14,005

Fireboat Repair Bids

Tenders were received on December 18 by the City of New York Fire Department, covering repairs to fireboat *Cornelius W. Lawrence*, and six proposals were submitted as follows:

Name	Price
Brewer Dry Dock Company	$6,439
Jakobson & Peterson	6,526
Todd New York Dry Dock Company	6,617
Sullivan Shipyards, Inc.	7,203
United Dry Docks, Inc.	8,035
Ira S. Bushey & Sons, Inc.	10,224

Dump Scow Repair Bids

The United States Engineer Office, First District, New York, received tenders on December 19 covering repairs to dump scows *E.R.20, 21,* and *22,* as follows:

Name	Price
United Dry Docks, Inc.	$6,498
Brewer Dry Dock Company	6,730
Todd New York Dry Dock Company	7,280
Jakobson & Peterson, Inc.	7,885
Caddell Dry Dock & Repair Company	8,465
D. Costagliola & Company, Inc.	11,273
Marine Basin Company	11,172
Jersey City Dry Docks	11,429

Ferryboat Repair Bids

Bids were received in New York on December 18 covering repairs to five ferryboats, with the following results:

Name	Price
Robins Dry Dock & Repair Company	$30,000
Brewer Dry Dock Company	32,000
United Dry Docks, Inc.	40,000
Ira S. Bushey & Sons, Inc.	42,000

Lighthouse Tender Repair Bids

Bids were received on December 23 by the Superintendent of Lighthouses, New Orleans, La., for docking and repairing lighthouse tender *Magnolia*, with the following results:

Name and Address	Price	Days
Johnson Iron Works, Dry Dock & Shipbuilding Company, Inc., New Orleans, La.	$5444	6
Alabama Dry Dock & Shipbuilding Company, Mobile, Ala.	5926	10
Bender Welding Machine Company, Mobile, Ala.	6482	20
Todd Mobile Dry Docks, Inc., Mobile, Ala.	6971	10
Todd Galveston Dry Docks, Inc., Galveston, Tex.	7221	12
Todd New Orleans Dry Docks, Inc., New Orleans, La.	7280	12
Pennsylvania Shipyards, Inc., Beaumont, Tex.	7880	12

Perkin Medal Awarded to Professor Lewis

The Perkin Medal of the Society of Chemical Industry will be presented to Professor Warren K. Lewis, of the Massachusetts Institute of Technology, at a meeting of the society on January 10, held jointly with the American Chemical Society. The award has been made in recognition of Professor Lewis' creative activities as the father of modern chemical engineering and his training of and inspiration to many of the present and potential leaders in the profession.

Business and Personal

The **Gould Storage Battery Corporation** has moved its eastern sales and service depot from 796 Tenth Avenue to 549 West Fifty-second Street, New York City.

Wilmer H. Cordes has been appointed manager of sales promotion and advertising of the **American Steel & Wire Company,** Chicago.

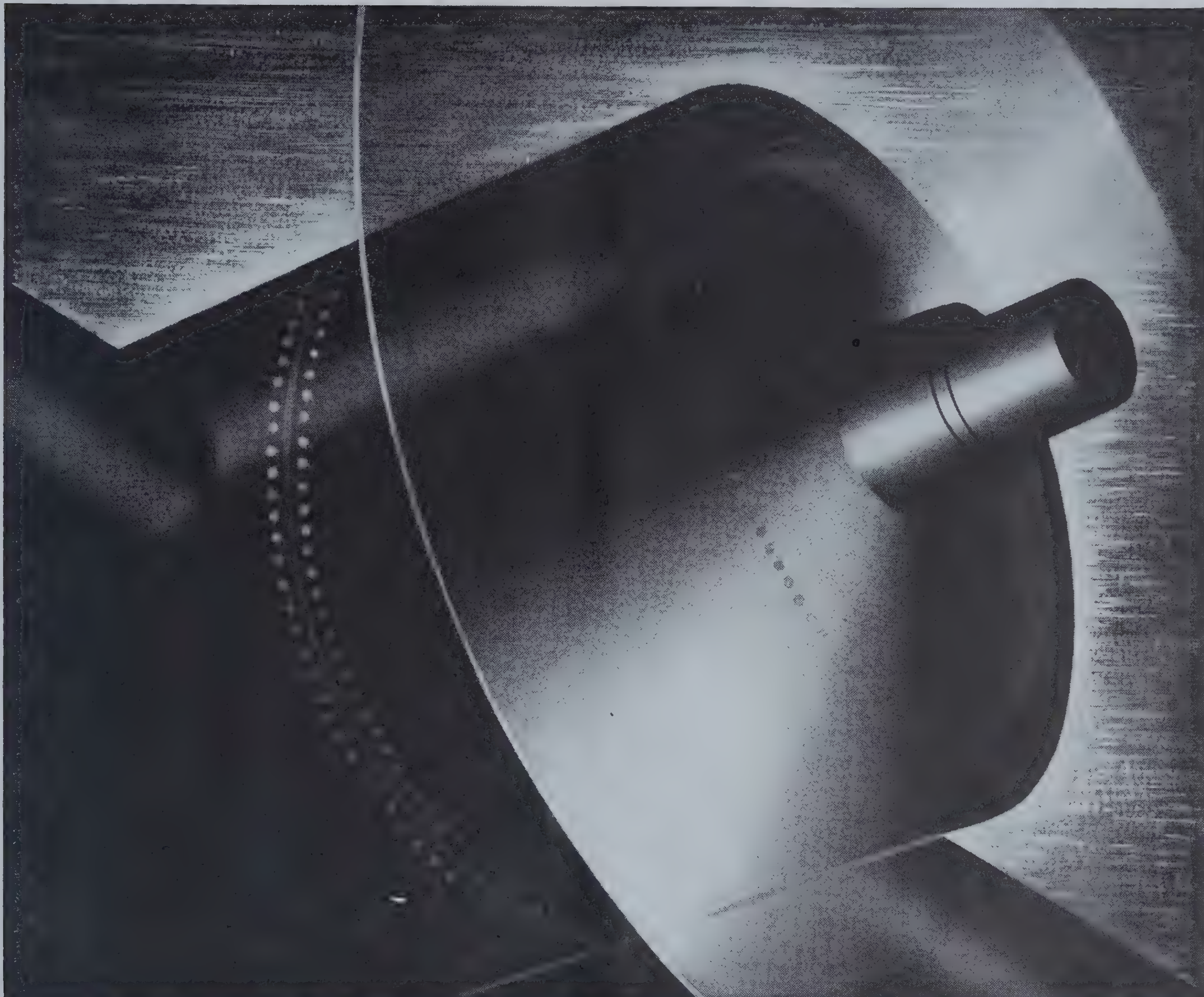
John S. Gregg, formerly of the **Moise Steel Company,** Milwaukee, Wis., has been appointed to the sales staff of the Milwaukee office of the **Inland Steel Company.**

Keith J. Evans, manager of sales promotion of **Joseph T. Ryerson & Son, Inc.,** has also been appointed manager of the sales promotion division of the **Inland Steel Company**

Joe Hare, formerly marine representative for **Richfield Oil Company,** Los Angeles, Cal., is now representing the **Shell Oil Company** as marine representative at San Francisco.

Captain J. H. Coppedge recently was elected president of the **Propeller Club, Port of Jacksonville, Fla.,** at a meeting of the club. **J. D. Weed** was elected vice-president, and **Captain J. H. Chapman,** secretary-treasurer.

T. G. Plant, vice-president and operating manager of the **American-Hawaiian Steamship Company,** San Francisco, is pleased to announce that **Ashfield Stowe,** his assistant, has been made manager of the **Williams Line** at Baltimore, Md.



MOLY makes better surface-hardening steels

It would be difficult to find a better test of surface-hardened steels than in airplane engines. Cylinders, knuckle pins, propeller shafts, crankshafts and various gears are subjected to particularly severe service. . . Hence the large number of instances in which such parts are made of Molybdenum surface-hardened steels.

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A more detailed account of "industry's most modern and versatile alloy" is given in our interesting technical book, "Molybdenum," which is yours for the asking. And, "The Moly Matrix," published periodically, will keep you informed on the latest Moly developments. Shall we put you on the mailing list? Climax Molybdenum Company, 500 Fifth Ave., New York.

MOLY

CUTS COSTS CLIMAX Mo-lyb-den-um CREATES SALES

Cutler-Hammer, Inc., manufacturers of electric control apparatus, Milwaukee, announces the advancement of **G. S. Crane,** sales manager, and **W. C. Stevens**, chief engineer, to vice-presidencies in charge of sales and engineering respectively. Mr. Crane, a graduate of the University of Michigan, began his service in the company's engineering department more than 25 years ago. He was later transferred to the sales department, serving for a time as manager of the company's Cleveland office, and for the past 12 years acting as sales manager with headquarters in Milwaukee. Mr. Stevens, a graduate of Cornell University, started with Cutler-Hammer 30 years ago in the engineering department, later spending 18 years in the sales department. Since 1924 he has devoted his time to engineering work, for the past several years as chief engineer.

G. S. Crane

W. C. Stevens

Frank V. Bush, sales office manager of the **Allegheny Steel Company**, Brackkenridge, Pa., has been promoted to service manager, succeeding **M. E. Harris,** who was recently promoted to assistant general manager.

According to an announcement by **N. J. Clarke**, vice-president in charge of sales for **Republic Steel Corporation,** the Cleveland district sales office has been moved from the **Union Press Building** to **920 Republic Building. W. E. Collier** continues in charge of the office as district sales manager.

Trade Publications

Refrigerating Units.—Details of two new Freon refrigerating units, products of the Frick Company, Waynesboro, Pa., are given in a recent bulletin. These units are designed especially to meet the needs of air conditioning and water cooling work.

Storage Tank Oil Heater.—A bulletin describing the construction and use of a new storage tank oil heater, manufactured by the Griscom-Russell Company, New York, has just been issued. This heater is specially designed for use aboard ships where fuel oil, lubricating oil and the like are to be conveyed from storage tanks to point of use.

Non-Sparking Tools.—The Superheater Company, New York, has recently sent out a catalogue on Elesco non-sparking tools. The use of these tools, it is stated, will prevent the emission of sparks with attendant fire or explosion where there are inflammable or explosive gases. Special hardening alloys are incorporated in the cutting tools.

Properties of Toncan Iron.—A folder containing a fund of condensed, up-to-date information on rust-resisting Toncan copper molybdenum iron has recently been issued by the Republic Steel Corporation, Massillon, O. Two important sections of this folder give complete physical properties and physical constants of this corrosion-resisting alloy iron.

Sectional-Header Boilers.—A catalogue illustrating and describing details of sectional-header type boilers as built by Combustion Engineering Company, New York, for a wide range of steam pressures, capacities and different methods of fuel firing, has recently been issued. In addition to details of design, cross-sections of numerous installations are included, as well as shop views showing the fabrication of such boilers and their inspection. In these boilers fusion welding is standard and riveted construction optional.

Winton News.—In the December issue of the bulletin featuring products of the Winton Engine Corporation, Cleveland, attention is called to the installation of two eight-cylinder Winton-Diesel engines in the yacht *Gem,* owned by William Ziegler, Jr. Each engine develops 200 horsepower at 1400 revolutions per minute. Two engines of this type will be displayed at the forthcoming National Motor Boat Show, Grand Central Palace, New York, January 17 to 25. In this edition also is described the modernization of the U. S. pipe-line dredge, *Pullen.*

Calendar.—The France Packing Company, Tacony, Philadelphia, Pa., is now distributing a 1936 calendar. This company manufactures metal packing for engines of all types and compressors.

Marine Societies

America

American Marine Standards Committee. Chairman, H. Gerrish Smith, 11 Broadway, New York.

American Society of Naval Engineers, Navy Department, Washington, D. C. Secretary and treasurer—Commander C. S. Gillette, U. S. N., Bureau of Engineering, Navy Department, Washington, D. C.

American Steamship Owners' Association, 11 Broadway, New York. President—R. J. Baker.

Diesel Engine Manufacturers' Association. Secretary and treasurer—M. J. Reed, 2 West 45th St., New York, N. Y.

Lake Carriers' Association, Cleveland, O. President—Joseph S. Wood. Vice-president, secretary and treasurer—George A. Marr.

Marine Association of New Jersey, 4th and River Sts., Hoboken, N. J. Secretary—Fred L. Broad.

National Association of Engine and Boat Manufacturers, 420 Lexington Ave., New York. Secretary—Ira Hand.

National Council of American Shipbuilders, Inc., 11 Broadway, New York. President—H. G. Smith. Counsel—Henry C. Hunter. Secretary—C. C. Knerr.

National Marine Engineers' Beneficial Association. Headquarters 313-316 Machinists' Bldg., Washington, D. C. President—William S. Brown. Secretary-treasurer—Albert L. Jones.

New York and New Jersey Dry Dock Association, 24 State St., New York. President—LeRoy W. Caddell. Secretary—Joseph F. McWilliams. Counsel—Henry C. Hunter.

Pacific American Steamship Association, San Francisco, Calif. President—J. C. Rohlfs.

The Maritime Association of the Port of New York, 80 Broad St., New York. President—E. J. McCormack. Secretary—F. D. Denton. Manager—C. H. Callahan.

The New York Tow Boat Exchange, 17 Battery Place, New York. Manager—Langdon W. Smith.

The Port of New York Authority, 111 Eighth Ave., New York. Chairman—Frank C. Ferguson. General Manager—John E. Ramsey. Secretary—L. J. Keefe.

The Propeller Club of the Port of New York. Secretary—A. C. Sickenberger, 17 Battery Place, New York.

The Propeller Club of the United States. President—C. H. C. Pearsall, 17 Battery Place, New York. Secretary—H. J. Harding, 95 Broad St., New York.

The Society of Naval Architects and Marine Engineers, 29 West 39th St., New York. Secretary and treasurer—H. Gerrish Smith.

United Licensed Officers of the United States of America. President—John F. Milliken, 80 Broad St., New York. General secretary—Bert L. Todd, 15 Whitehall St., New York.

United States Naval Institute, Annapolis, Md. Secretary and treasurer—Commander A. B. Anderson, U. S. N.

United States Ship Operators' Association, 17 Battery Place, New York. President—J. T. Lykes. Secretary and treasurer—Lon Hudson.

Great Britain

Institute of Marine Engineers, Incorporated, 85-88 The Minories, London, E. C. 3.

Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow.

Institution of Naval Architects, 2 Adam St., Adelphi Terrace, London, W. C. 2.

North East Coast Institution of Engineers and Shipbuilders, Bolbec Hall, Westgate Road, Newcastle-on-Tyne.

France

Association Technique Maritime et Aëronautique. Secrétariat Général—7, Rue de Madrid, Paris (8e)

COOPER-BESSEMER N-LINE DIESELS at the MOTOR BOAT SHOW

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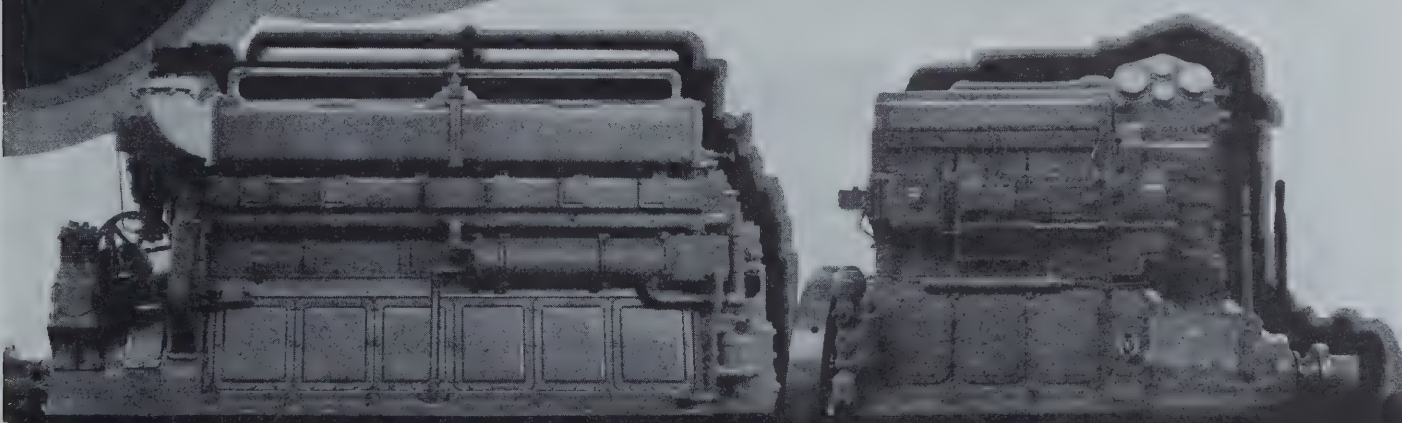

TYPE GN—Rated from 35 H. P. per cylinder at 300 r. p. m. to 75 H. P. per cylinder at 600 r. p. m. Engine illustrated is direct-reversing, and equipped with sailing clutch.

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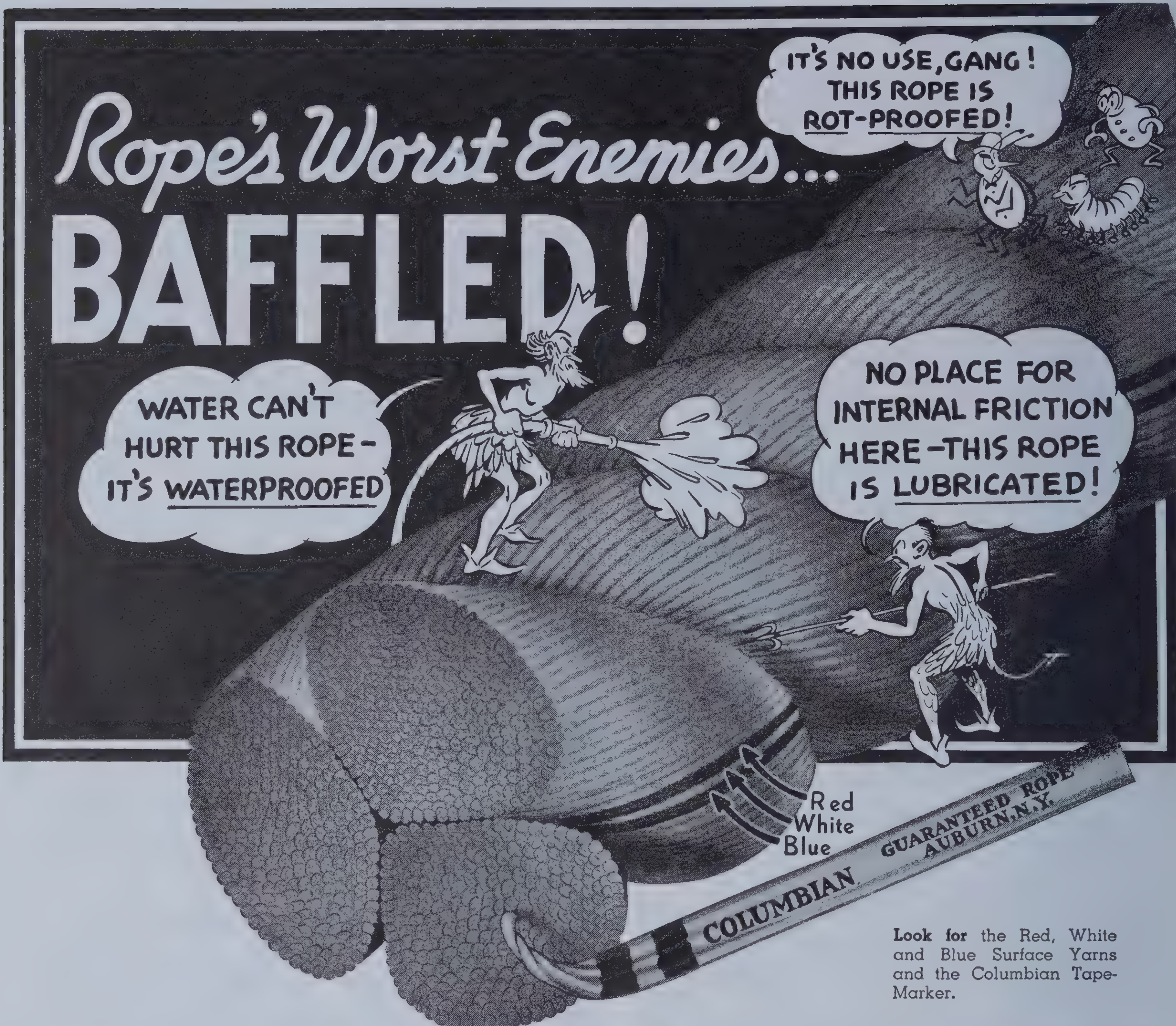

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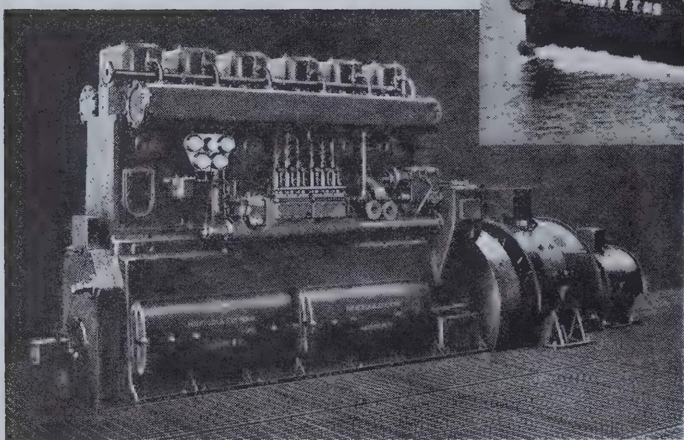
at Pearl Harbor ...HAWAII



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